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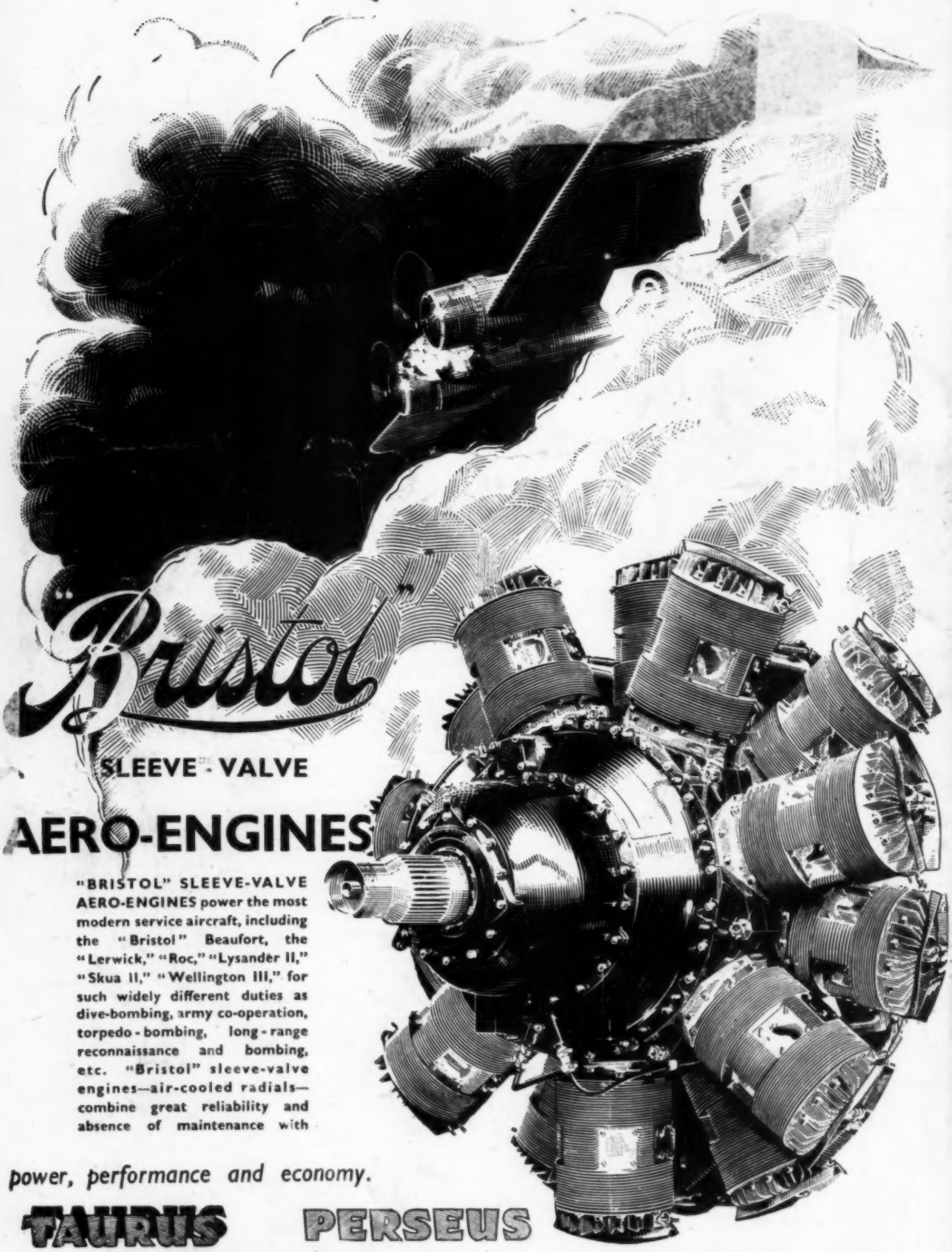

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The Outlook

The Pacific Front

TRAFALGAR Square crowds have clamoured for the opening of a new front in the West, and Russian spokesmen have openly confessed that they are not much impressed by our air bombing of German industrial cities, and long for the day when we and the Americans can land in France. That is easy to understand, and every Briton, too, longs for the day when it may be possible. At the moment, however, we have more fronts to contemplate than is really convenient, considering the state of our own and American production. The Battle of the Atlantic is the most crucial of all, for were we to lose that, Hitler's greatest obstacle would be removed. Affairs in the Middle East cannot be called satisfactory while Rommel is still threatening Egypt, and finally there is the Pacific front, which means just now the defence of Australia.

All these fronts call for more ships, more aircraft, and more guns. It must be very hard for our war rulers to decide on the priorities, when each front seems almost equally vital. The Japanese are pushing forward, more slowly than they moved at first, but still steadily, in the direction of Australia, and the people there are naturally disquieted. Port Moresby must be held, and an army is in position on the mountain range which separates it from the Japanese bases to the north. That army is not able to take the initiative, and so Australian defence is carried on by bombing aircraft. It is an expedient which only just suffices, and had it not been for the American victories of the Coral Sea and Midway Island, it might not suffice.

It is part of the general strategy of the United Nations that the United States must undertake the reconquest of the Pacific, and when she has gathered sufficient naval strength (including an air arm) there is no doubt that the operation will be easily within her power—provided that Sydney Harbour is available as a naval base. Now that Singapore and the Dutch East Indies have fallen there is no other suitable base. The Japanese are well aware of this, and are likely to strain every nerve to capture that base before American power becomes too much for them. Sydney is of prime importance in the Pacific war.

Already it is the United States which has to grapple with the problem of priorities, for Russia and China need help, while General Auchinleck depends mainly on American aircraft, and American forces are beginning to gather in strength in the United Kingdom. But the offensive in the Solomons is cheering.

Tobruk Harbour Prospects

IT is one of the griefs of Bomber Command that it cannot arrange a "four-figure" raid on German cities every night or every week because heavy and medium bombers are constantly allocated to Allies or overseas Commands. Recently, we may presume, the chief sources of its discontent have been Russia, India and Australia. It had been announced as a deliberate policy that the Middle East (apart from Malta) should be supplied almost entirely from the United States. The staff of Bomber Command heard with equanimity, and doubtless with satisfaction, of the good work done there by Marylands and Liberators. Now, however, it has been announced that Halifaxes have joined the muster under Air Marshal Tedder, and we may picture the staff of Bomber Command figuratively wringing its hands.

Such announcements are not usually made until it is certain that the Germans have discovered the fact for themselves. That does not necessarily mean that a

Halifax has been shot down over Tobruk, but with the Allied front line withdrawn so far into Egypt as it is at present, it must be almost impossible to prevent the enemy's reconnaissance machines from discovering what lies behind General Auchinleck's front. We have heard little of German raids on our airfields, though enemy bombers have made small-scale raids on Alexandria, the outskirts of Cairo, and on the Canal zone, but the hostile reconnaissance machines have been ranging far and wide at great heights, and have probably reported most of the facts which the Germans would like to know. We may also assume that Halifaxes are present in some numbers.

The Liberators have done very good work, as have the Wellingtons from Malta, but too much stuff for our liking has been getting through to Rommel. The sinkings of Axis shipping on the way to Libya, by submarine, air torpedo and bomb, have lately not kept pace with the arrivals in the Libyan ports. It has become an urgent matter to sink more of the ships in the harbours of Tobruk and Benghazi, and also to damage the facilities for unloading in those ports. The Liberators, useful as they are, are not adapted to carry the heaviest type of bomb, and for that reason, we may presume, they have been reinforced with Halifaxes, whose bomb compartments will accommodate two-ton bombs.

Big Stuff

THE announcement from the United States that Mr. Henry Kaiser is to be given a chance to prove his claim that he can get into production quickly with large cargo aircraft focuses attention once again on the subject of long-range aircraft of great carrying capacity.

For a beginning, Mr. Kaiser will be given the task of building 100 flying boats of the Glenn Martin Mars class. In this connection it may, perhaps, be recalled that in June, 1939, we published an article by an American correspondent on projects which several American aircraft constructors had on the drawing board. These included a Seversky twin-hull flying boat and a Sikorsky single-hull, six-engined boat. These, however, were no more than projects at the time, while Glenn Martin was already well under way with the construction of a large flying boat, which was originally designed the XPB2M-1, and has since been launched and named the Bars.

It would be difficult to imagine a better example of the advantage of getting out a prototype early than that provided by the Martin Mars. Not only has it been flying for a considerable time (its flights including some very long trans-oceanic journeys), but the drawings are all available, and all that is necessary to get into production is the tooling and jigging. That is, of course, in itself a large task, but far smaller than if all design work had to be started now. Thus Mr. Kaiser may be able to prove his assertion that he could get into production in less than a year. One can only regret that British designers are prevented by circumstances from showing what they can do. We know that several of them have studied the problem of large aircraft very seriously, and would welcome the opportunity to put their ideas into practice. Now they must watch with envy the wonderful opportunity given to their American "opposite numbers."

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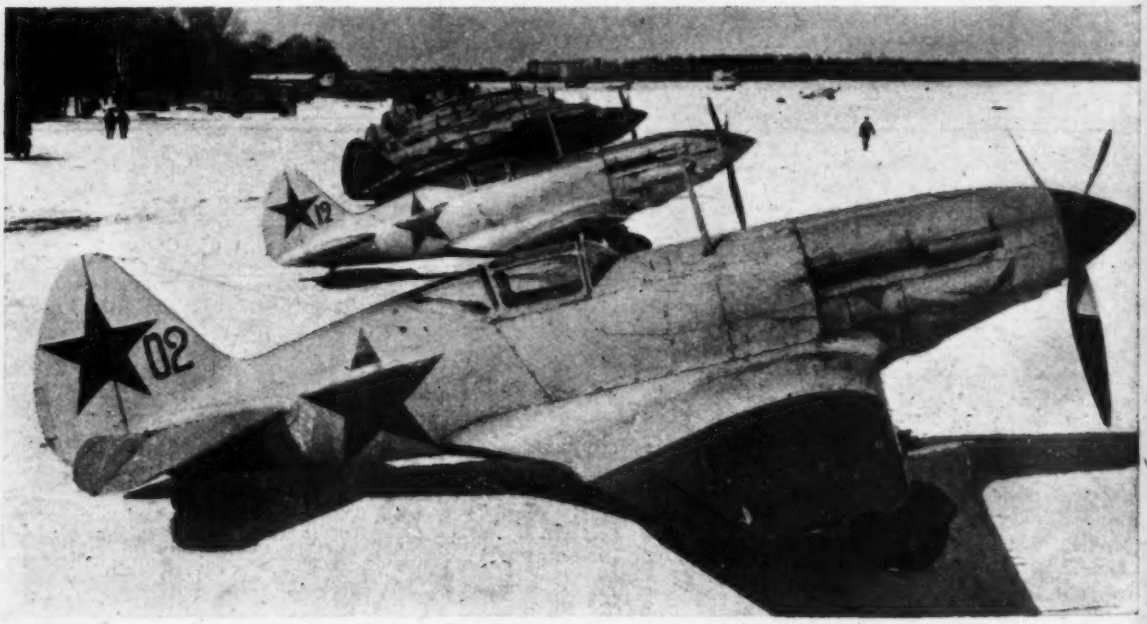
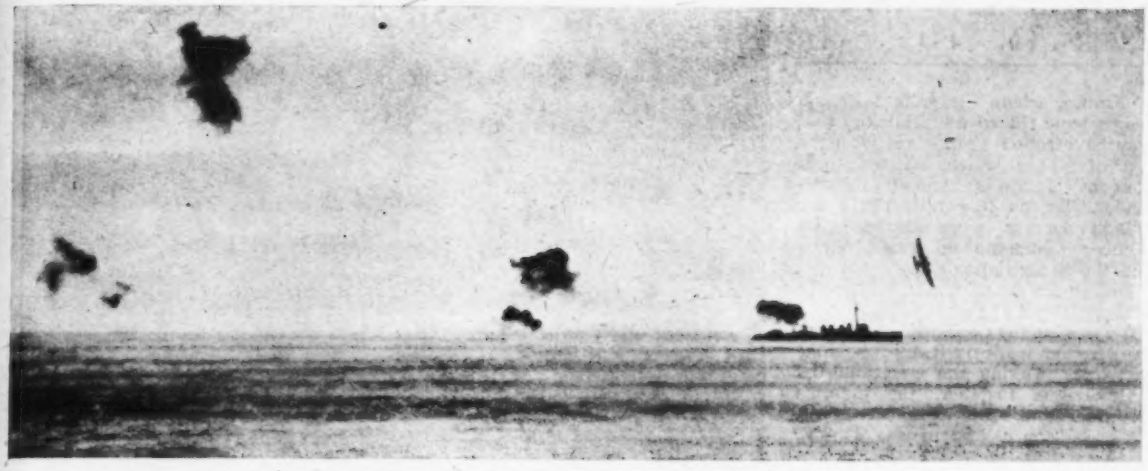


EAST FRONT FIGHTER-BOMBER : A line of MIG.3 single-seat fighters on a Russian airfield. The MIG.3 has a 1,200 h.p. A.M.35A liquid-cooled engine and is credited with a top speed of 360/370 m.p.h. Light and heavy machine guns are fitted, and for ground strafing bombs are carried in external racks under the wings.



SEVENTY-FIVE DEGREES NORTH: A torpedo-carrying Heinkel 111 attacking one of our Russian-bound convoys. This Heinkel was shot down into the sea shortly after the photograph was taken.

War in the Air

July Records : The Bombing of Dusseldorf : Burma and the Far East

JULY was not a fine month, and the R.A.F. felt the effects of the poor weather. Bomber Command was only able to operate on 16 nights and 18 days, while the R.A.F., as a whole, could only take the offensive on 18 nights and 23 days. These figures lay stress on the regular night operations of Fighter Command. In a recent article in these columns mention was made of the particular attention which our fighters have been paying to goods trains and railway locomotives in occupied territory. It should be added that many of the attacks are made by night, when it is not possible to black-out completely the lights from an engine. Railway lines too often show up at night, and, doubtless, flares make assurance doubly sure. Nine goods trains were destroyed in Belgium on the 25th. It is hoped that this interference with enemy rail traffic prevents a considerable amount of supplies from reaching the Eastern Front, and so gives real help to the Russians. The work of "intruder" fighters, which shoot down enemy bombers by night over their own bases, should likewise not be forgotten.

Both R.A.F. Commands have worked on a well-thought-out plan. Of the attacks on German industrial centres 27 have been made on 14 targets. No "four-figure" raids were made during the month, but on ten occasions there were "three-figure" attacks on targets in the Reich. The daylight attack on Danzig was one of the outstanding features of the month's work.

The month was also notable for the participation of bomber units of the American Army, which took part for the first time on July 4th.

We have reached a point in the struggle when leaflets dropped from the air may have more definite results than they had when dropped over Germany in the first eight months of the war. Propaganda is now directed

TEA UP, CHAPS!: A scene in the galley of a Sunderland on patrol over the Mediterranean Sea.

WAR IN THE AIR

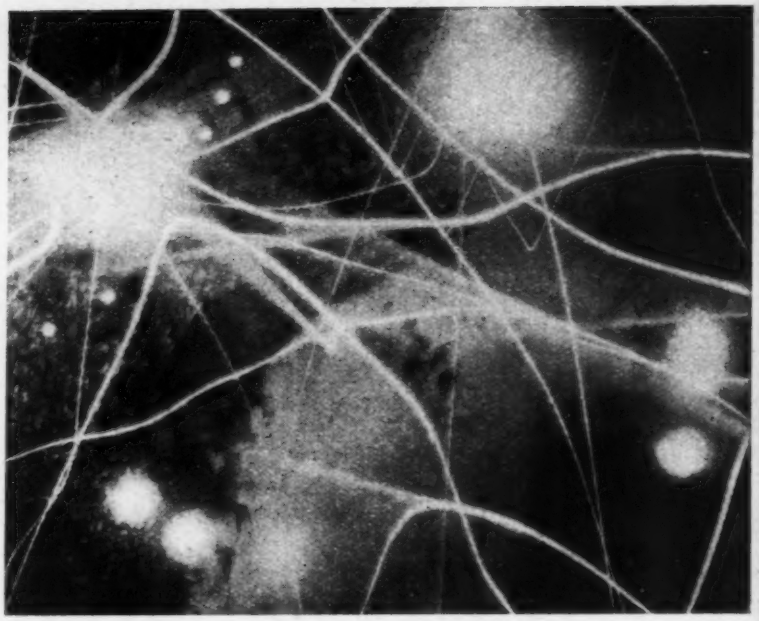
to France, where the gallant French people have shown unmistakably that they have roused themselves from the sort of stupor which afflicted them after the German invasion and the surrender. So, on July 14th nearly five million leaflets were dropped by Bomber Command on Paris, Vichy and the industrial north.

During the month the R.A.F. in the west destroyed 113 enemy aircraft and lost 251 over the Continent or the sea. In defensive work no R.A.F. machine was lost. Taking the west and the Middle East together, the month's record shows 420 enemy aircraft destroyed for a loss of 432 R.A.F. machines.

Malta deserves separate mention. During July 147 enemy aircraft were destroyed in defence of the island, 133 by fighters, six by A.A. fire and eight by means not stated. The A.A. fire also drove off or disorganised many attacks without scoring definite hits.

Düsseldorf

AFTER Saarbrücken, Düsseldorf; two nights after, to be accurate. Who would care to live and work in the Ruhr? Düsseldorf is one of the largest centres of heavy industry, especially steel and engineering, in Germany. Among its products are component parts for motor vehicles, aircraft, and warships, torpedoes, mines, heavy guns, shells, bombs, grenades, armour plates, and explosives. The centre of the town is a very congested area. Its industries lie both in and around the town, and some especially important plants are in the suburbs. The town of Düsseldorf itself has about 350,000 inhabitants and 150,000 on its outskirts.



BENGHAZI BATTLE. Bomb and gun flashes and streaks from tracer shells create a weird pattern as our bombers make a night attack on the much-battered Cyrenaican Harbour.

Yet Düsseldorf was taken by surprise. Perhaps the defenders thought that the Saarbrücken effort had exhausted the R.A.F. for a while, and that they could count on a quiet night. So, when the first Lancaster arrived over the place on the night of July 31st, the pilot saw the city lying quiet below him in the moonlight. There were no guns and no searchlights. One wonders what had happened to the German observer corps and all the *flak* gunners along the route which the British bombers followed. Their trips are not usually so uninterrupted.

The crash of the Lancaster's bombs broke the silence, and at once pandemonium broke out down below and up above. The British bombers followed thick and fast. They were mainly Lancasters, but all operational types were represented. Over 150 bombs of the 4,000-lb. calibre spread havoc in the heart of the city's industries, and others of all sizes mingled with them, while hundreds of thousands of fire-bombs lit up the scene. It was all over in 50 minutes, and the bombers turned back for home. Thirty of them had been lost, but not all necessarily over Düsseldorf, for there were diversion attacks by other bombers and by fighters on other places. At least four enemy night fighters were shot down by the gunners in the turrets of the attacking force.

To these devastating attacks by Bomber Command, the only reply which the Germans have been able to make has been a series of "tip-and-run" raids by night and day, though sometimes a moderate force has been scraped together and has penetrated by night into the Midlands, bombing Birmingham or some other town. The day raiders have just nibbled (so to speak) at the East and South Coasts, and if the pilots think that they are safe for the moment from Spitfires, they indulge in a little enjoyable machine-gunning of harmless civilians in the streets. We all know that the German can fight bravely, but nothing so pleases his Hunnish nature as killing and torturing when his own skin is in no danger at all. That shows him that he is in truth one of

DÜSSELDORF RAID. Smoke drifting across the city the day after the big raid by the R.A.F. in which thousands of incendiaries and 150 4,000lb. blast bombs were dropped.

ENEMY AIR LOSSES TO AUGUST 8th.

	Over G.B.	Over Continent.	Middle East.
July 26	0	9	1
,, 27	1	1	18
,, 28	9	2	6
,, 29	10	3	2
,, 30	8	9	1
,, 31	1	15	6
Aug. 1	1	1	0
,, 2	4	0	0
,, 3	1	1	1
,, 4	6	0	2
,, 5	0	1	2
,, 6	0	0	0
,, 7	1	1	1
,, 8	0	1	3
	42	44	43

Totals: West, 6,159; Middle East, over 4,403.

WAR IN THE AIR

the *Herrenvolk*. His latest trick is to drop phosphorous bombs. F.W. 190 fighters have been seen carrying large bombs. None the less, these little raids of his have been by no means devoid of danger and loss, as the table given in this page shows. One night six raiders were destroyed out of about 30 which came over. British night fighters grow more and more experienced and deadly as time goes on, and the German losses in these nuisance raids are out of all proportion to the profit they bring to the German war effort.

There have been many air combats lately over the Bay of Biscay, where Coastal Command has been carrying on its campaign against the U-boats. Sunderlands, Beaufighters and Whitleys have all been engaged, and have shot down a number of floatplanes and other enemy aircraft there. One does not often hear of Whitleys being in action nowadays, but those still in the possession of Coastal Command can still fly and can still shoot straight, in addition to carrying as many bombs as ever.

The Middle and Far East

THE lull in the Battle of Egypt lasted for an unexpectedly long time, and presumably both sides are amassing reinforcements. Two points deserve special notice, namely, the consistently good work done by naval aircraft along the enemy's coastline and against his convoys, and the arrival of Halifax bombers to strengthen the hitting power of General Auchinleck and Air Marshal Tedder against Tobruk and the other ports in Axis hands. The lighter bombs used hitherto have not done enough damage to the port facilities in those places. We know from our own experience during the great blitz on Great Britain that it takes a lot of bombing to put a port out of action.

Hitting the Japanese

THE Americans have launched two naval and air attacks on the Japanese in the Pacific, one on the Aleutian Islands, which the enemy has occupied, and the other against the Japanese positions in the Solomon Islands. Australian air forces are taking part in the latter. The main attack was preceded by methodical heavy bombing raids on airfields in adjacent islands so as to prevent aircraft from them interfering in the main action or creating diversions. It is clear that the plans for these operations were drawn up some time ago, but the secret was well kept. At the moment of writing no details of the fortunes of the battles have been published, but it is very heartening to know that the United Nations are at last really on the offensive.

BRITISH AIR LOSSES TO AUGUST 8th.

	Over G.B. A'crft.	Over Continent B'brs.	Over Continent F'trs.	Middle East A'crft.
July 26	0	29	3	3
,, 27	0	2	0	2
,, 28	0	33	3	5
,, 29	0	9	3	6
,, 30	0	0	13	3
,, 31	0	30	9	9
Aug. 1	0	5	0	0
,, 2	0	0	1	6
,, 3	0	1	1	5
,, 4	0	1	1	0
,, 5	0	5	1	3
,, 6	0	6	0	2
,, 7	0	0	0	5
,, 8	0	0	0	5
	0	121	35	54 (13 pilots safe)

Totals: West, 4,356; Middle East, about 1,554

Many Adventures

IN China the American Army bombers and fighters have been very active, and not long ago some of them made a surprise raid on the harbour of Hong Kong, where they damaged some Japanese shipping. The American contingent in India has devoted much effort to denying to the Japanese unrestricted use of the airfield at Myitkyina. The lighter bombers of the R.A.F. in India have mostly bombed Akyab.

An admirable feat has been performed by an American shipyard on the east coast of the States by launching the carrier *Essex* 15 months after the keel had been laid down. Very good work!

ICE PACK PATROL. The floating ice menace is a far older enemy of shipping than the U-boat and one of the most wearisome jobs of Coastal Command is the ice pack patrol over Northern Waters. It is work which calls for super-skill in navigation and piloting because the location, drift and direction of ice packs must be accurately ascertained. (Left) Drifting ice packs as seen from a Coastal Command Hudson. (Above) Air crews reporting to the Intelligence Officer after a patrol.

HERE AND THERE

Intelligent Anticipation

A PIECE of practical post-war planning is in the announcement of Jersey and Guernsey Airways to the effect that in response to many applications they have opened a waiting list for those desirous of returning to the Channel Islands by air as soon as the islands are freed of enemy occupation.

Aircraft Types

OWING to unusually heavy demands this week on our space the usual recognition feature, "Aircraft Types and Their Characteristics," has unavoidably been held over.

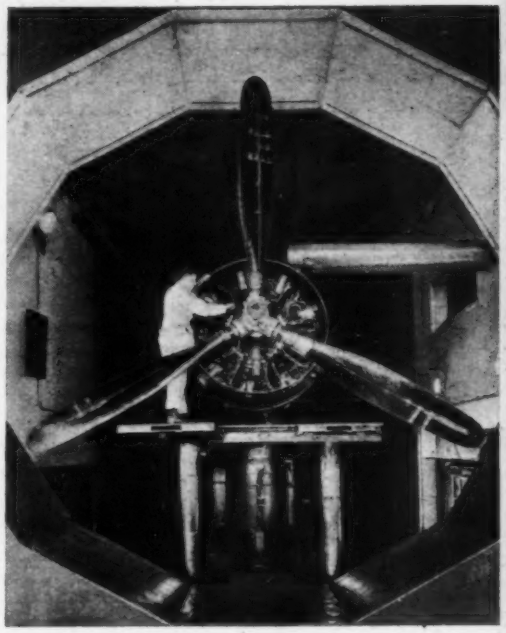
Instead, the two centre pages are, as readers will see, devoted to a special Max Millar drawing of Britain's latest bomber, the Avro Lancaster, which is fully described in the adjacent pages.

Two other features of outstanding interest in the present issue are the description of the 14-cyl. two-row B.M.W. radial engine, also illustrated by a Max Millar sectional drawing, and an article on the Focke-Wulf Fw.190 single-seater fighter to which this engine is fitted.

Gloster's Gas Exhibition

WITH the object of making all employees throughout the Hawker Siddeley Combine thoroughly alive to the potential perils of an enemy gas attack, the management of the Gloster Aircraft Co., Ltd., decided to arrange a poison gas exhibition in their own works and those of their associated companies.

The exhibition, which has been visited by the great majority of the employees at each factory during meal breaks, and has won the co-operation of local civil defence authorities, contains, among other things, a great pile of damaged gas-masks discovered by A.R.P. inspection, examples of gas-contaminated articles and a range of anti-gas weapons and equipment.



HIGH, WIDE AND HANDSOME! Reported to be the biggest in the world, the new 18ft. Curtiss electrically operated airscrew for high altitude work is here seen in a test cell. It was designed primarily for a new U.S. Navy flying boat.

New Dunlop Director

SIR ALEXANDER AIKMAN, C.I.E., has been appointed a director of the Dunlop Rubber Co., Ltd. Sir Alexander, who is a director of Andrew Yule and Co., Ltd., was a member of the Legislative Assembly of the Indian Central Legislature from 1936-1939 and leader of the European Group in India during the years 1938-1940.

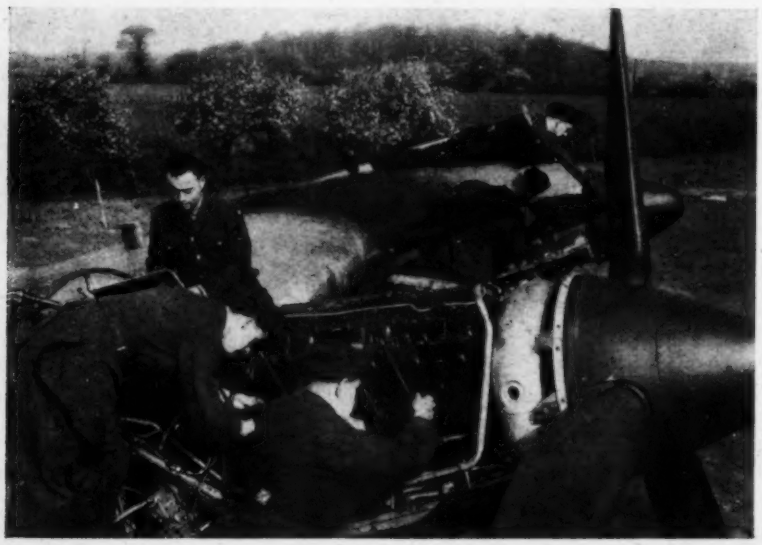
He has also been a director of the Dunlop Rubber Co. (India), Ltd.

Death of Wing Cdr. C. A. Ridley

WING CDR. C. A. RIDLEY, D.S.O., M.C., who served in the R.F.C. in the last war and who, together with another officer, was officially credited with having destroyed the first Zeppelin, the L.15, brought down off the mouth of the Thames, died recently after a long illness.

He was well known in the field of light aircraft before the present war, and on retiring from the R.A.F. towards the end of the 1920's he joined his brother's firm, Auto Auctions, Ltd., and opened a light aircraft department which became the sole distributors for the Blackburn Bluebird in 1929.

On the outbreak of the present war Wing Cdr. Ridley rejoined the R.A.F., and at the time of his illness was commanding the Leeds University Air Squadron, and was, in fact, this squadron's first commanding officer.



REFRESHING A GIANT. Fitters at work on the Rolls Royce Merlin engines of a Handley Page Halifax between "ops" over enemy targets. It will be seen that the power units are so accessible that a complete cylinder bank can be removed with the engine still in its nacelle.

Land Girls' Typhoon

THE first Hawker Typhoon fighter to be bought for the R.A.F. by women was donated by the Women's Land Army, which raised just over £5,600 for this purpose. Land Girls all over the country collected the money and Miss Irene Marshall (W.L.A. 25199), representing Worcestershire, the county which headed the fund by raising 12s. 10d. per head, had the honour of presenting the cheque recently to Sqn. Ldr. Barry Heath, D.F.C.

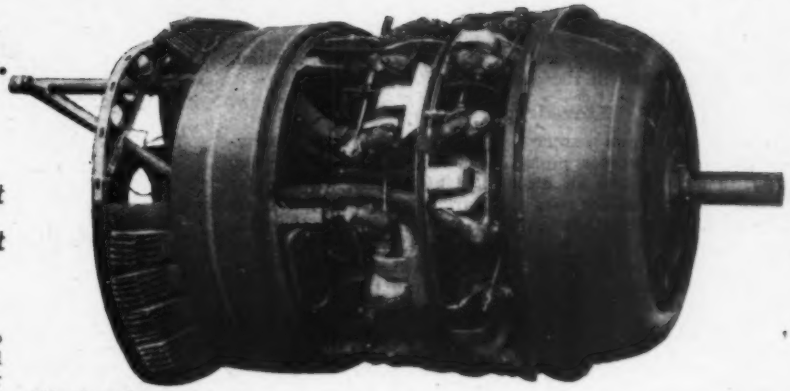
The presentation was made the occasion of a little ceremony at the W.L.A. office in Oxford Street, London, at which Lady Denman, Honorary Director of the W.L.A., presided, and Mrs. Hudson, wife of the Minister of Agriculture and Mr. A. B. Mash, Public Relations Dept. of M.A.P., were also present.

Sqn. Ldr. Heath, who has more than 150 "ops" to his credit, received the cheque surrounded by a bevy of attractively healthy-looking land girls in their green jerseys and khaki breeches, and caused a laugh by saying that this was the most frightening day of his life, but that he was particularly pleased that Worcestershire had topped the list since it was his own county.

THE B.M.W. 801A

Details of Germany's Latest Twin-row Radial Power Plant

By F. C. SHEFFIELD



Side view of a complete unit taken from a Dornier 217 bomber. One of the blower intakes is on the lower left. The internal air scoop is attached to the cowling. A panel removed from the nose gives access to the magneto.

B.M.W. 801A	
Type	14-cylinder, twin row, radial.
Bore and Stroke	6.15in. × 6.15in.
Swept capacity	42 litres.
Overall dimensions	52in. dia. × 58in. long.
Rated Output	1,460 b.h.p. at 16,300ft.
Take-off power	1,580 b.h.p. for 3 min.

IT would be somewhat misleading to refer to the power unit employed on the Focke-Wulf 190 and Dornier 217 machines merely as the B.M.W. engine. In the fullest sense it is a complete power plant, conceived and constructed as a compact whole. Here is no question of an engine fitted with a number of auxiliaries and enclosed in a cowling whilst coolers and air scoops are added externally. The idea may not be novel in conception, but the practice is new in production and of outstanding interest.

Using the fourteen-cylinder air-cooled twin-row radial B.M.W. engine as a basis, the aim was to obtain the maximum power output whilst reducing overall dimensions and frontal area to a minimum and presenting an aerodynamically smooth exterior. Everything is subordinated to this end.

Many ingenious constructional features are employed, and the practical result must be regarded as a justification of the design. Within a cowling of 52in. diameter and having an overall length of 58in. is packed a remarkable power output. The rating under various conditions is as follows:—

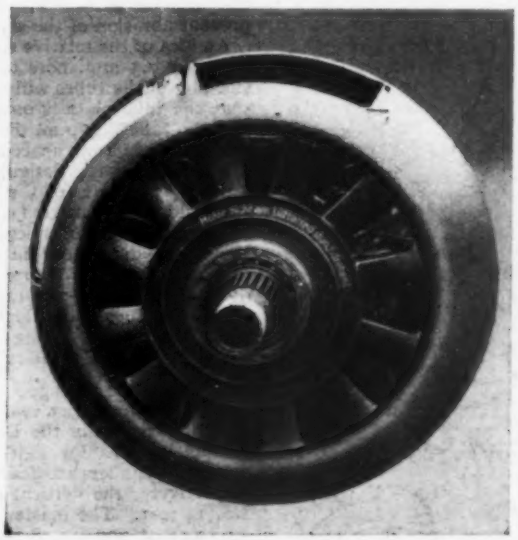
	Boost	r.p.m.	b.h.p.	Altitude
Take off	1.32 atm.	2,700	1,580	
Emergency maximum	1.3 ,,	2,550	1,585	15,750ft.
International rating	1.27 ,,	2,400	1,460	16,300ft.
Continuous maximum	1.15 ,,	2,300	1,280	18,500ft.
Economical cruising	1.1 ,,	2,100	1,125	19,500ft.

To achieve the low overall diameter the cowling closely encircles the 50in. diameter engine and is supported by front and rear rings and an inter-cylinder baffle ring, all attached to the valve rocker boxes by rubber-bushed bolts. Special measures are taken both to introduce the requisite amount of air and to ensure its distribution throughout the interior.

Cooling Fan

At the front end the cowling is faired down to shroud a twelve-bladed magnesium alloy fan of 32in. diameter. The fan is driven from the airscrew reduction gear at 1.72 times crankshaft speed, which is equivalent to 3.17 times the airscrew speed. An adequate air flow is thus assured when the engine is running on the ground or in flight at low speeds.

Of course, considerable power is required to drive a fan of this size, and it is estimated that 100 h.p. is needed for this purpose at the take-off. When the aircraft has a forward speed of 170 miles per hour, however, the fan is motored round by the air stream, and no power is absorbed directly. The loss of 100 h.p. of the critical take-off output must be reckoned a disadvantage, but this is offset by the advantages in flight conferred by a positive cooling air flow and by the small diameter low-drag cowling. It is an indication of how the unit is considered as a whole.



Front view showing the fan which is driven at 1.72 times crankshaft speed. It supplies all air for the engine, cylinder cooling, oil cooling, and cabin and wing heating.

Exit of air from the interior of the cowling is by way of two circumferential slots controlled by sliding gill rings, as indicated in the diagram of the airflow system. Each of these gill rings is actuated by an electric jack and a push-pull cable. A series of bell crank levers spaced around the diameter of the support member and coupled to the gill ring and an equaliser ring ensure axial movement, giving a uniform annular slot. The rear ring, controlling the airflow past the cylinders, has two positions only, with an axial movement of 3.12in. Maximum and minimum discharge areas, after deducting the cross-sectional area of the exhaust pipes which project through this slot, are 3.7 sq. ft. and 1.2 sq. ft. respectively. The forward ring, sealed to the shrouding of the cooling fan by a flexible rubber joint, is variable throughout its permissible axial movement of 1.12in. to control the reverse flow of air from the interior of the cowling through the oil coolers. This slot has a maximum area of 0.73 sq. ft.

Internal Air Scoops

The air intake for the supercharger is also completely inside the cowling, and fed from the air delivered by the fan. Two shallow segmental scoops are fitted inside detachable sections of the cowling on each side of the engine. It is, of course, not practical to make a normal bolted connection, and actually the junction is effected by the flange of the

scoop abutting a soft rubber joint on the supercharger intake as the cowling section is drawn down to position. This is indicated in the detail sketch.

Low-drag Cowling

By these means a smooth exterior having low aerodoynamic drag becomes possible. There are no protruding gills or scoops, and air discharged by way of the annular slots flows smoothly over the surface without materially disturbing the exterior flow. In this will be seen the major advantage of such a completely enclosed power plant. The airscrew fitted to the unit under examination was of the three-bladed fully feathering type of an estimated diameter between 12ft. 9in. and 13ft. The spinner, however, was only 19¼in. diameter, and no fairings were fitted to the blade roots.

The two rows of cylinders are relatively closely coupled and particular care has been taken, by means of what appears at first to be a most elaborate system of baffles, to ensure an adequate and uniform flow of air over the barrels and heads. The method employed can best be seen in the detailed sketch. Around the barrels, laterally spaced baffles on the front row allow air to pass around the fins and be projected between the cylinders of the rear row. The spaces between the baffles on adjacent front-row barrels form ducts leading to the entrances of similar baffles on the rear row of cylinder barrels.

The shrouding for the heads is somewhat more elaborate. On the front row, air is passed over the head and diverted by the inter-cylinder baffle ring down the rear of the head and past the fuel-injection nozzle located between the valve ports. The uppermost part of the shrouding on each cylinder head forms a scoop which takes a portion of the air passing over the head and delivers it through the inter-cylinder ring to prevent the formation of low-pressure areas at this position.

For the rear cylinder heads air flows through apertures in the inter-cylinder ring and is delivered in two streams over the valve ports. A small centrally disposed duct running from a third aperture in the ring directs a stream of air downwardly between the ports and past the fuel injector to the rear of the cylinder.

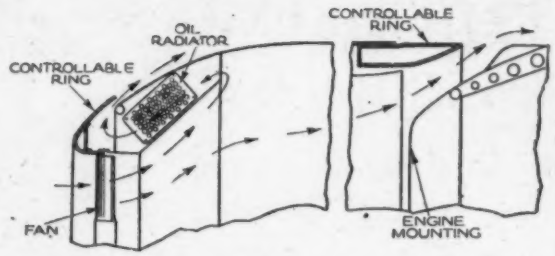
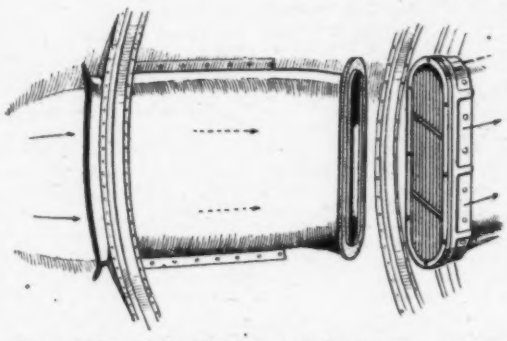


Diagram showing the air-flow in the cowling. The sliding gill rings are each operated by an electric jack.



One of these internally mounted air scoops on each side of the unit conduct air to the blower intakes.

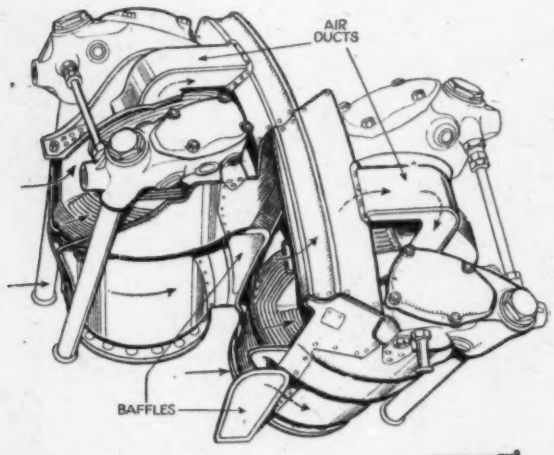
Oil Coolers

Two segmentally-shaped oil coolers, one on each side of the unit, are housed between the cone extending from the fan shroud and the nose fairing of the cowling. Each cooler comprises a stack of 60 finned light alloy tubes arranged in 12 staggered rows of five. The tubes are approximately 43in. long, and detachably mounted in the light alloy tube plates to which the end covers are bolted. Inlet and outlet are located in the same cover, the flow being up two rows of tubes and down two rows, with three changes of direction in one cover and two in the other, as indicated in the diagrammatic sketch.

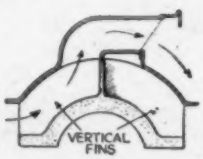
The method of securing the tubes in the plate is shown in a separate drawing. Each hole is tapered for about half the thickness of the plate and the remainder is screw-threaded to a larger diameter. The cylindrical end of the tube is centred in the hole by a tapered bush of soft aluminium alloy which is wedged into position by a screwed steel ferrule to anchor and seal the tube in the plate. A steel washer is interposed to prevent abrasion of the soft bush by the end of the ferrule.

An idea of the relative size of these parts will be obtained from the 7.5 mm. bore of the tube. Similarly, the close stacking of the tubes will be appreciated when it is realised that the tube plate is only approximately 4½in. by 8½in., and the tubes, 17 mm. diameter over the fins, are pitched at 18.5 m. in rows spaced at 16 mm.

As regards basic design, the engine would appear to be a lineal descendant of the Pratt and Whitney Twin Wasp. It should not be inferred, however, that it is a slavish copy but rather that it invites a general comparison. There is nothing derogatory in such a design practice and, in fact, any country or organisation embarking on the production of a twin-row radial engine would be foolish to ignore the highly developed American designs.



This sketch shows the system of baffles employed to ensure distribution of air for cylinder cooling. The barrels are closely shrouded and special measures are taken to direct air over the heads and downwardly to the rear.



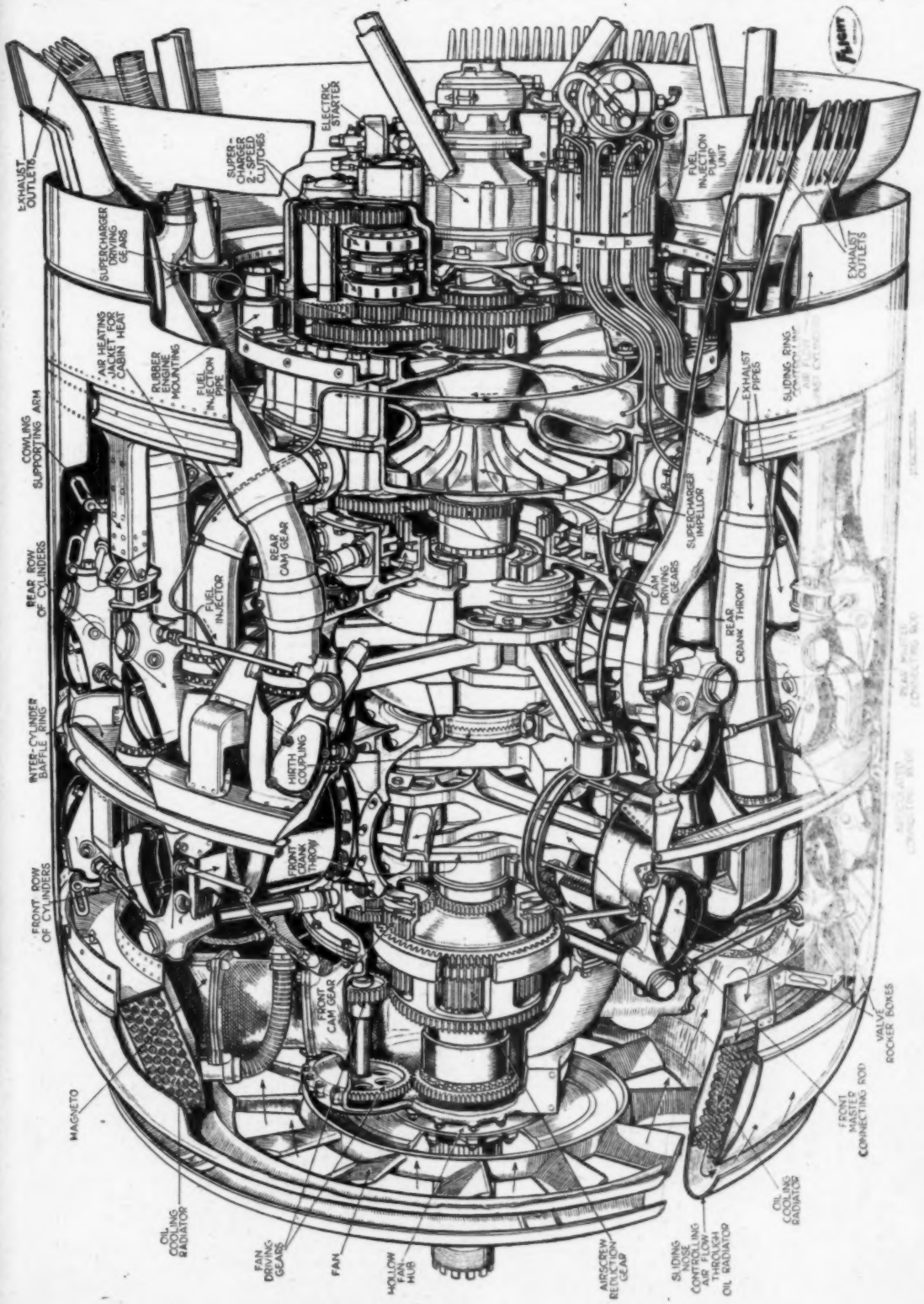
Cylinder Arrangement

Cylinders are arranged in staggered rows with the lowest front and uppermost rear cylinders positioned vertically. On both engines of the Dornier 217 machine the direction of rotation was for right-hand tractor airscrews. Front and rear cylinders are designated by odd and even numbers respectively, the vertical cylinders being No. 7 front and No. 14 rear. The master connecting-rods are in cylinders No. 9 front and No. 8 rear, which are the lowest on the port side in each row, as shown in the part-sectioned general assembly drawing.

The cast-steel crankcase, divided into three sections on the transverse planes containing the cylinder axes, provides

THE B.M.W. 801A

An air-cooled 14-cylinder twin-row radial engine of 42 litres, developing 1,580 b.h.p. at 2,700 r.p.m. for take-off

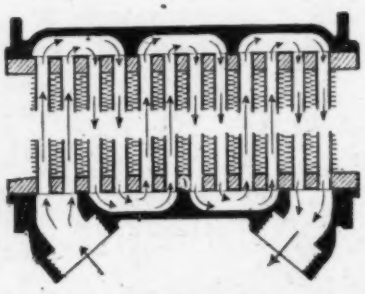


This part-sectioned perspective drawing of a unit taken from a Dornier 217E bomber shows the arrangement of the running gear and the main equipment drives. The type 801D unit installed in the Focke-Wulf 190 A-3 fighter has a few modifications. The more significant of these is a non-adjustable nose ring slot for the oil-cooling system and the absence of flame-damping fittings on the exhaust pipes.

THE B.M.W. 801A

a rigid foundation for the engine structure. One factor contributing to this aim for rigidity is the method of constructing and supporting the crankshaft to reduce the axial length to the minimum. The shaft is built up of two central webs, each with a crankpin and half the centre journal, and front and rear webs with integral journals. At the centre journal the two webs are coupled by the patented Hirth joint.

Both the halves of the journal are hollow and furnished with inter-engaging face serrations, while the axial bores are screw-threaded, one with a relatively fine pitch and the other with a relatively coarse pitch. A suitable screwed bushing, splined internally for the assembly tool, draws the two parts together by the differential action of the screw threads.

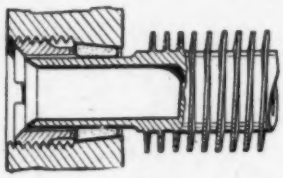


Diagrammatic section showing direction of flow through the multi-tube, nose-mounted oil coolers.

Assembled on the centre journal is a large diameter single-row ball-bearing, which is relatively narrow and thus enables the rows of cylinders to be closely spaced. Bronze rings are fitted on each side of the bearing, enabling the inner race to be securely clamped between the webs without impeding the draw of the Hirth joint.

Crankshaft Assembly

e pressed-in joint of the crankpin in the outer web, 1.W. development, is shown in a sectioned drawing. ne parallel bore of the ye of the web is fitted a ronze liner having a red bore. This liner nchored by a pressing eration which causes the metal to flow into an annular groove in the web. The end of the hollow crankpin, tapered both internally and externally, is pressed into the lined web until it abuts a shoulder. From the opposite direction a tapered, copper-plated steel bush is pressed into the end of the pin. Thus the joint is completely contained within the width of the web. Internally, the bush is screw threaded to receive an extracting tool when it is necessary for the joint to be dissembled.



Oil cooler tubes are secured by a tapered bushing and a screwed ferrule.

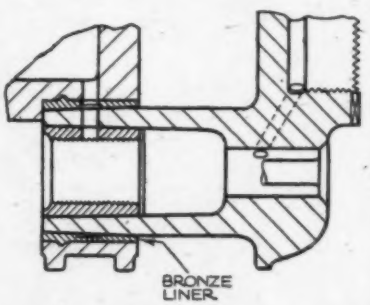
All four webs are formed with integral bob weights and are drilled to accommodate an alignment bar during assembly. In the rear web are also drillings for torsional vibration damping weights, but in the 801A engine under examination these were blanked off with solid metal plugs. It is of interest to note that the outer races of the central ball bearing and the two main roller bearings are all permitted to progress rotatively in undivided bronze bushes in the crankcase.

It will be noted that by adopting a "square" instead of a "long stroke" design for the engine the crank throws are reduced, giving a stiffer shaft, the dimensions of the crankcase are lessened and the diameter over the cylinders is reduced. The crankcase breathes through ducts cast in the blower casing into the accessories-drive housing. The discharge from here is by way of a pendulum-type barrel valve located in the air-intake half of the blower casing. This valve shuts off at approximately 90 deg. from the vertical and prevents loss of oil during aerobatic manœuvres.

To the forward end of the crankcase is flanged and bolted the housing accommodating the airscrew reduction gear, the cooling-fan increasing-gear and the single drive for the vertically-mounted twin Bosch ZM14 CR10 magnetos. The reduction gear is of the epicyclic type, lowering the speed of the airscrew to 0.54 times that of the crankshaft. From a gear cut on the casing of the epicyclic unit the drive is taken through a layshaft to a pinion on the hollow fan hub which, as previously mentioned, is rotated at 1.72 times crankshaft speed.

Auxiliary Equipment

At the rear end of the crankcase, co-axially with the crankshaft, is flanged the blower casing, which is divided into two registering parts forming intake and delivery members. On the rear of the intake half is registered the robust channelled and bossed light alloy ring by which the complete unit is suspended from the aircraft. Long bolts passing through the blower housing to the steel crankcase secure this assembly.



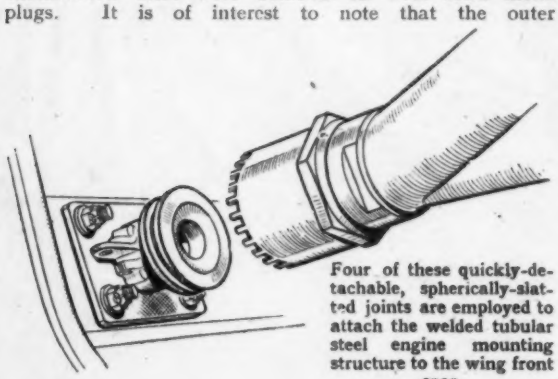
Pressed-in joint of the built-up crankshaft. The expansion bush is screwed internally for an extractor tool.

Separately bolted to the rear face of the intake half of the blower casing is the accessories housing. The extended end of the crankshaft passes through the hollow impeller shaft and carries the supercharger drive gear and auxiliary drive gear and the starting dog for engagement by the co-axially mounted inertia type starter. This unit is of Bosch manufacture and is energised electrically, or in the event of emergency by hand cranking.

Other auxiliaries mounted on the rear of the engine and directly driven from the crankshaft by spur gears are a 2-kW Bosch generator, an Askania vacuum pump, a Maihak fuel supply pump and the Deckel fuel injection pump. The last mentioned unit differs from previous Deckel pumps and has the 14 plungers lying parallel to, and evenly spaced around, the driving axis.

Details of this pump and the new type of fuel injection nozzle will be given in a succeeding article.

In the two-speed supercharger drive unit two gears furnished with multi-plate clutches are free to rotate on the



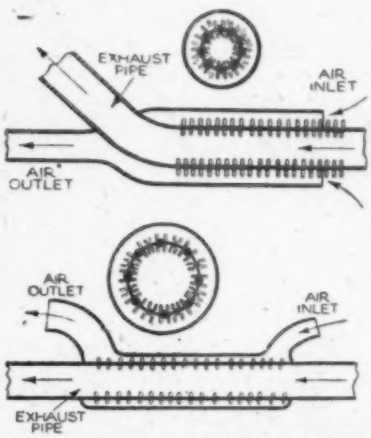
Four of these quickly-detachable, spherically-slatted joints are employed to attach the welded tubular steel engine mounting structure to the wing front spar.

THE B.M.W. 801A

output shaft carrying the large diameter gear in engagement with the pinion on the impeller shaft. Located between the two free gears and slidably splined on the output shaft is the selective clutching member, which is hydraulically operated from the control unit.

For the higher ratio the drive is taken directly from the forward free gear driven from the crankshaft pinion to the output shaft to give an impeller speed of 7.46 times crankshaft speed. The low ratio of 5.07 times crankshaft speed is obtained when the rear free gear is clutched. The drive is then transmitted from the crankshaft through the first free gear and then by way of a layshaft to the second free gear and in turn to the output shaft.

The semi-shrouded impeller is of light alloy and 13.3in. diameter. It has 24 blades and each alternate blade is extended over the hub to form the so-called entry fan.



(Upper) Exhaust muff for wing de-icing and bomb compartment warming.

(Lower) Muff for cabin heating and transparency de-frosting system.

Apart from recording a general straightforward design and robust construction, connecting rods, pistons, cylinders and valve gear call for little comment. A minor point deserving attention is the method of attaching the cylinder barrel to the crankcase. As the crankcase is of steel there is no necessity to boss the cylinder aperture for long studs. By using a special circular nut with a serrated periphery the studs can be positioned radially close to the cylinder wall and only a narrow circular flange is required. As will be noted on a front row cylinder on the assembly drawing, a large number of relatively small diameter studs, evenly pitched around the barrel, is employed.

One inlet valve and one exhaust valve are provided for each cylinder and operated by roller-ended tappets, tubular push-rods and individually housed overhead rockers. The exhaust valve is of the hollow, sodium-cooled type.

All ports are directed to the rear and there is no manifolding of either inlet or exhaust systems. Individual pipes run from the blower casing to each inlet port and from the exhaust ports individual pipes extend to the rear and pass through the cowling slot behind the gill ring.

Exhaust System

Each exhaust pipe terminates in a flame-damping fitting having five passages approximately 3in. long and ⅜in. wide which project about 4in. beyond the diameter of the cowling. No shroud or screen is fitted to obscure glow during night operations and no attempt is made to exploit the exhaust for propulsive effect as the discharge is directed radially outwards.

Two exhaust pipes are fitted with muffs to supply warmed air to the cabin. For each a 1¼in. diameter pipe conducts air from between the two rows of cylinders to the muff, which is fitted concentrically around a section of the exhaust pipe provided with a number of tongues riveted internally and externally, as shown in the sketch, to assist radiation of heat. A 2½in. diameter pipe leads to a common control valve and from this a lagged pipe delivers to the cabin space.

Floor level discharge orifices are arranged near the feet of the pilot or crew, and hot air sprays are fitted to the pilot's windscreen and the transparent panels of the enclosure. On a twin-engined machine such as the Dornier 217 each engine serves one side of the cabin and two members of the crew of four.

A further two exhaust pipes are furnished with muffs of different pattern (see sketch) to draw air from the cowling enclosure and heat it for wing de-icing and bomb-compartment warming. There can scarcely be any question of the efficacy of these systems, as a notice in the Dornier cabin warns the pilot of the danger of overheating if the control is left in the "warm" position.

As may well be imagined, this multiplicity of pipes and muffs, together with all the usual equipment and appurtenances of an engine, results in a degree of congestion inside the cowling which must be seen to be believed.

The perspective general assembly drawing conveys a good impression of the apparent complexity. In this, however, two cylinders have been removed and certain items in the foreground cut away to expose the running and driving gear. Thus more can be seen of the engine from front to rear than is possible on lifting a section of the cowling on the actual unit.

The exhaust pipes are arranged to terminate in three outlet groups, with six at the top and four on each side. Obviously, a great amount of thought and care has been devoted to the layout of the equipment. Equally obviously, assembly, maintenance and repair cannot be as straightforward as is desirable, despite conveniently hinged inspection panels and a readily demountable cowling. This is part of the price to be paid for the small overall diameter and the clean exterior.

Doubtless, the unit is not intended to receive extensive maintenance work whilst in position on a machine. Instead, the installation layout suggests a policy of ready removal from the machine and quick attachment of another serviced unit. Four suspension loops for lifting tackle will be noted on the upper cylinder rocker boxes and self-sealing couplings are provided for fuel and oil lines.

Resilient Mounting

The engine support is a welded tubular steel structure secured by four bolts to a tubular steel mounting ring. This is attached to the channelled light alloy ring on the rear of the blower-casing by ten large-diameter rubber-bushed mounting blocks. They are positioned four at the top and four at the bottom and one on each side. At the rear the tubular structure is connected by four spherically seated joints to fittings on the wing front spar. The spherical joints are fitted with large castellated nuts which are locked by spring-loaded pins, as shown in the sketch.

The forward overhang of the unit from its supporting member is considerable. It is known that the B.M.W. concern was interested in a form of stressed cowling which also serves as an engine supporting structure. Some scheme on these lines may possibly appear as a later development, particularly if more powerful engines having more than two rows of cylinders are produced.

In next week's issue further particulars of this interesting power unit will be given, including details of the fuel injection equipment and the lubricating oil system.

Companion articles in this series of descriptions of prominent aircraft engines of the war appeared in the following issues:—

BRISTOL HERCULES	*November 27th, 1941.*
ROLLS-ROYCE MERLIN XX	*February 26th, 1942.*
ALLISON	*March 26th, 1942.*
MERCEDES-BENZ D.B.601N	*April 16th, 1942.*

The AVRO LANCASTER

Full Details of Our Latest and Fastest Heavy Bomber : Excellent Controllability and Amazing Two-engined Performance : An Aircraft Without Vices

THE impression has got around that the Avro Lancaster heavy bomber is merely a four-engined version of the twin-engined Avro Manchester. This is very far from being the case, and the Lancaster should be regarded as a completely new type. That certain structural components from the older machine have been incorporated in the design, where they were suitable, is admitted; it would have been an inexcusable waste of man-power not to have done so. That the design has not suffered as a result is amply proved by the fact that the structure weight of the Lancaster is less than 30 per cent. of the gross weight, a figure which points to a very high degree of structural efficiency. That there is a "family likeness" is but natural, and, indeed, it would have been strange if such had not been the case. The wing form, the placing of the engines, the fuselage form, and the tail surfaces had all been found extremely successful on the Manchester, so Mr. Roy Chadwick, Avro's chief designer for more than twenty years, would have been very unwise to make changes in these items. His justification, from a structural point of view, has already been mentioned. Aerodynamically, it is to be found in the fact that the Lancaster is the fastest, by a considerable margin, of our heavy four-engined bombers.

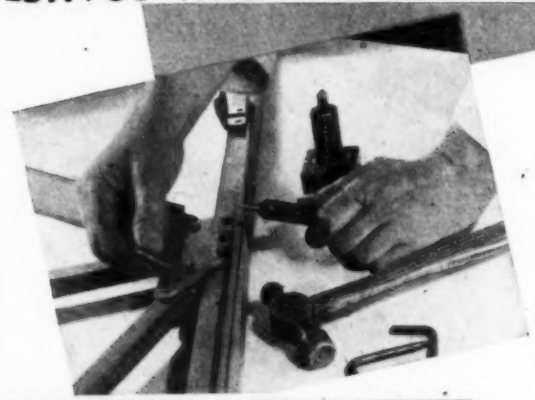
The qualities of an aircraft are not to be measured in sheer performance alone; controllability, freedom from vices, and the ability to fly with one or two engines out of action are at least as important. In that respect, too, the Lancaster has already proved its worth. It is on record that on one occasion one of these machines returned from the Baltic with both engines on one side out of action, and the airscrew blades of another badly bent so that the engine had to be throttled down in order to reduce vibration. The aircraft got back safely, virtually on one-and-a-half engines, and both of these on the same side!

Mr. Roy Chadwick has been chief designer of Avros for more than twenty years. In that time a great many designs were produced, two of which have been built in greater numbers than any other type: the 504 in the first world war and the Anson in the present. In addition to being chief designer he is now a director of the firm.

It is natural to ask what has made the Lancaster probably the finest four-engined bomber in the world. The answer cannot be given in a few words. The low structure weight is due partly to the constructional methods adopted, and to a very careful proportioning everywhere of the structure members to the loads they have to carry. Yet this has been achieved without undue complication; in fact, the Lancaster structure is a relatively simple one from the manufacturing point of view, as even Mr. R. H. Dobson, managing director of Avros, admits. We use the word advisedly, for "Dobbie," as he is called throughout

WINGS ARE THE WHEELS OF TO-MORROW

GENERAL AIRCRAFT LIMITED



A.D.M. 373 (issue 5) says that Serrated Rivets to G.A.L. Drawing, No. D.16543 (sheets 2a and 2b), as approved in A.D.M.275, may be used wherever there are production advantages in so doing.

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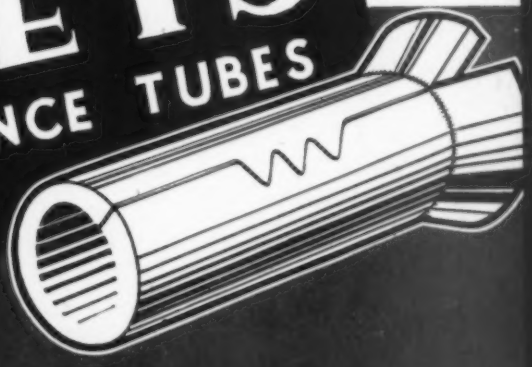

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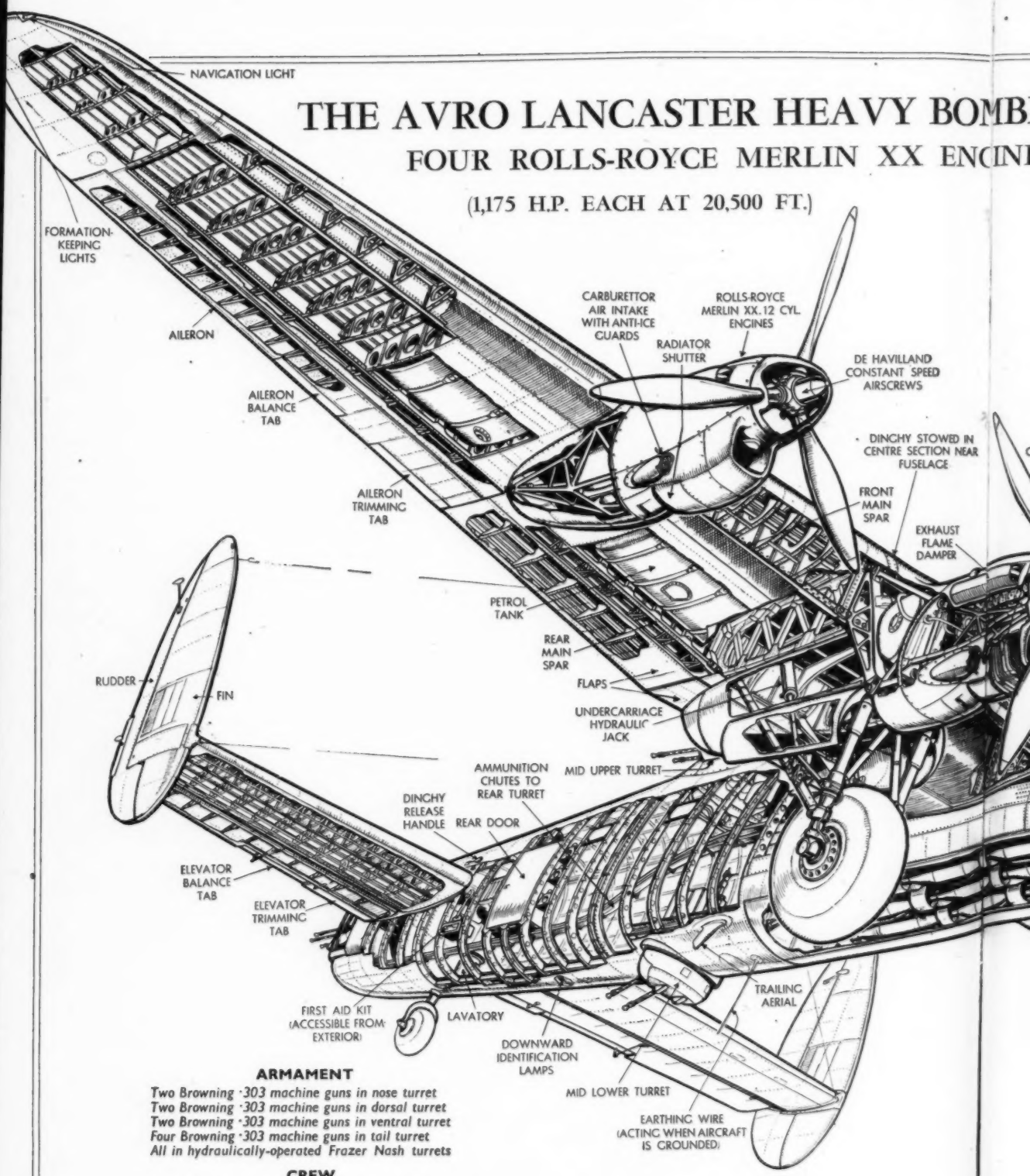
THE AVRO LANCASTER HEAVY BOMB

FOUR ROLLS-ROYCE MERLIN XX ENGINE

(1,175 H.P. EACH AT 20,500 FT.)



ARMAMENT

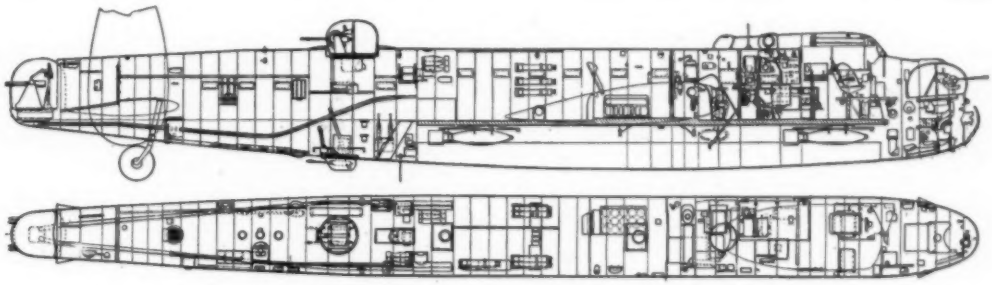
Two Browning ·303 machine guns in nose turret
Two Browning ·303 machine guns in dorsal turret
Two Browning ·303 machine guns in ventral turret
Four Browning ·303 machine guns in tail turret
All in hydraulically-operated Frazer Nash turrets

CREW

Normally six : Captain ; second pilot ; air observer (navigator/bomb-aimer) ; two radio operator-air gunners ; air gunner

FLIGHT

BOMBER
ENGINES

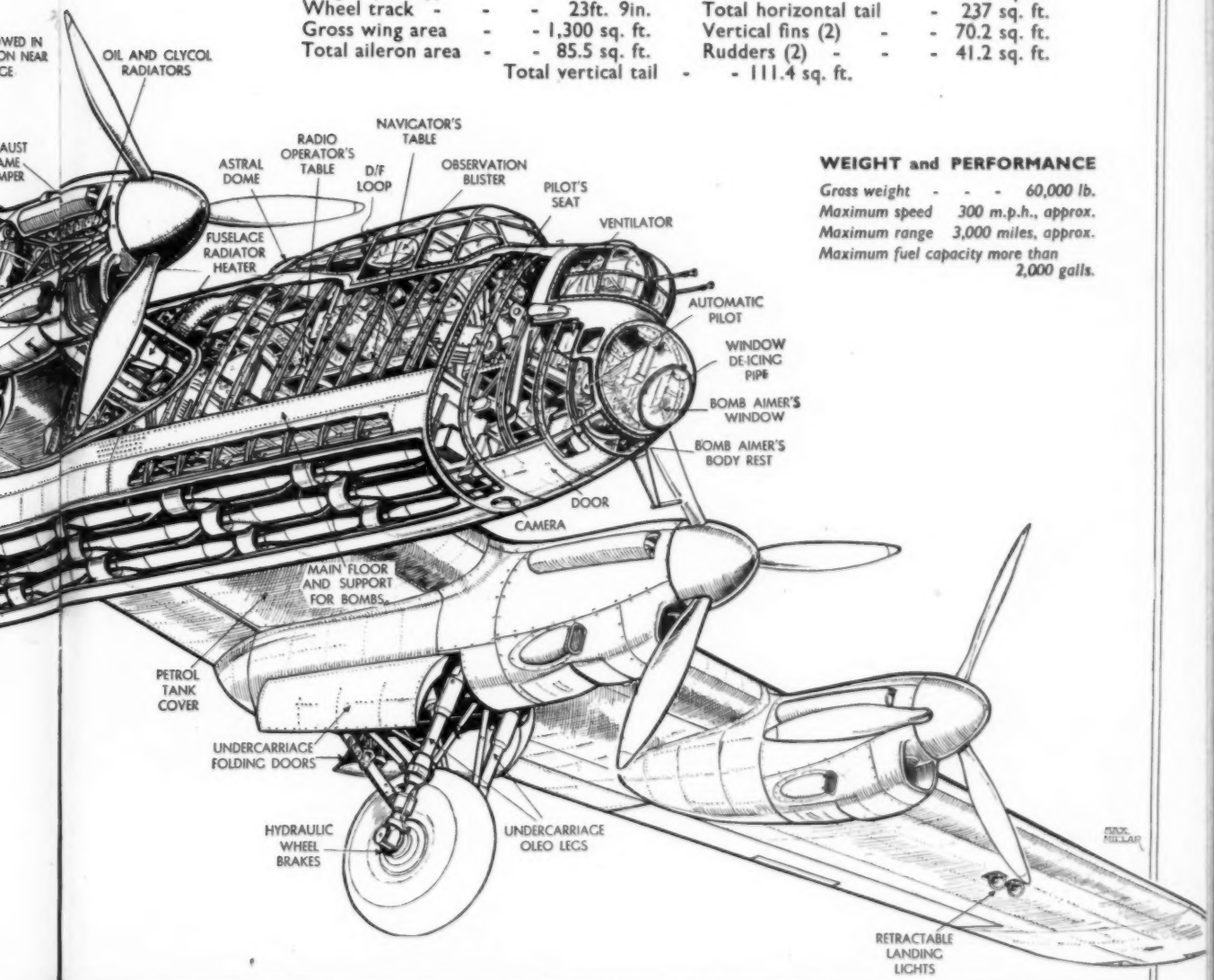


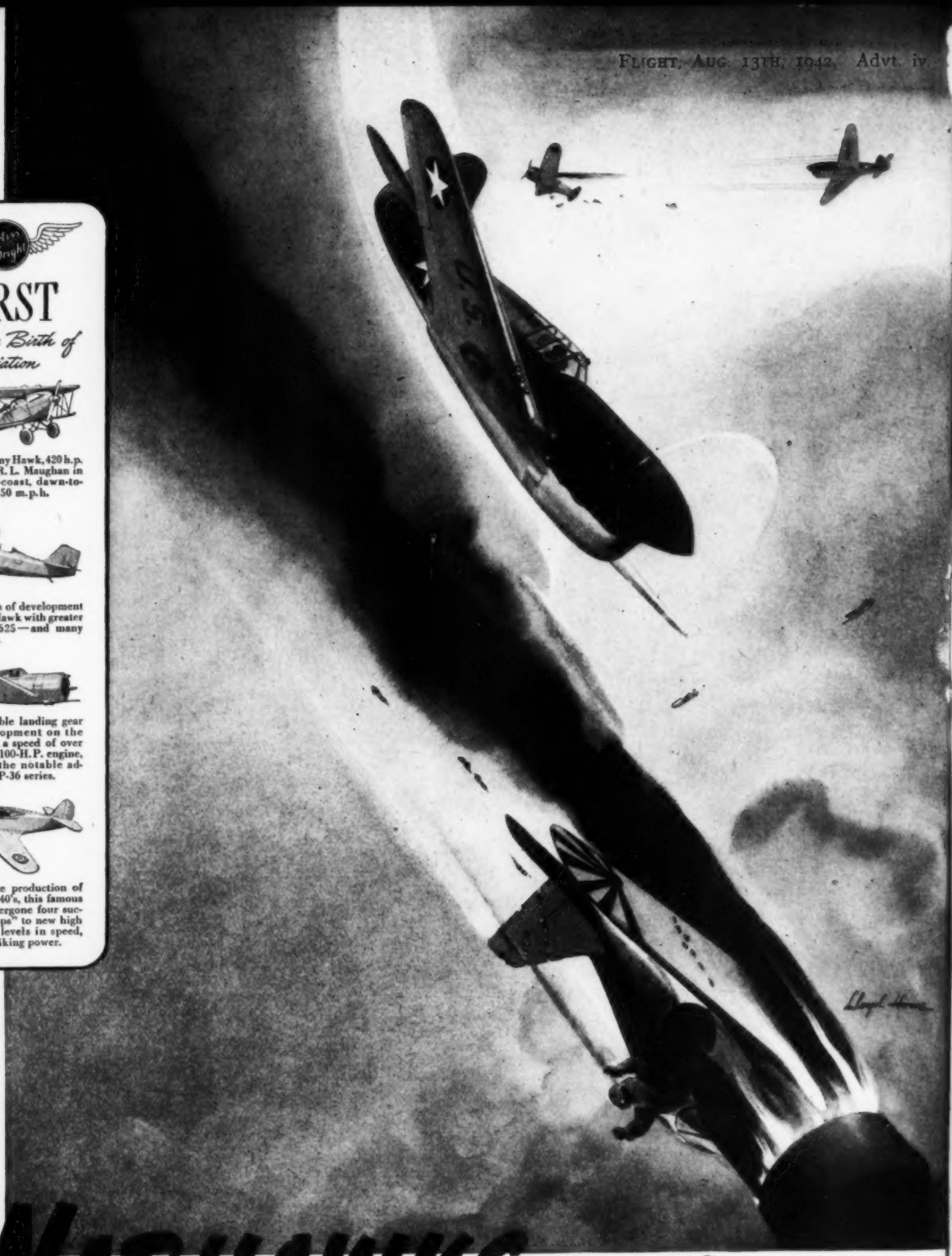
PRINCIPAL DIMENSIONS

Length o.a.	69ft. 6in.	Total flap area	146 sq. ft.
Wing span	102ft. 0in.	Tailplane	149.5 sq. ft.
Height (tail up)	20ft. 6in.	Elevators	87.5 sq. ft.
Wheel track	23ft. 9in.	Total horizontal tail	237 sq. ft.
Gross wing area	1,300 sq. ft.	Vertical fins (2)	70.2 sq. ft.
Total aileron area	85.5 sq. ft.	Rudders (2)	41.2 sq. ft.
Total vertical tail	111.4 sq. ft.		

WEIGHT and PERFORMANCE

Gross weight - - - *60,000 lb.*
Maximum speed *300 m.p.h., approx.*
Maximum range *3,000 miles, approx.*
Maximum fuel capacity more than 2,000 galls.





WARHAWKS for Victory

From the start, Curtiss P-40's have been in the thick of nearly every important air combat the world over. Back home, without a halt in desperately needed production, these famous fighters have undergone many successive step-ups in performance. Now a still greater P-40, the Warhawk, with its hard-hitting fire power, will soon be winning new victories in America's march toward all-out air supremacy.

CURTISS-WRIGHT
Corporation

FIRST
Since the Birth of Aviation

1923•First Army Hawk, 420 h.p. Flown by Lt. R. L. Maughan in first coast-to-coast, dawn-to-dusk flight—150 m.p.h.

1929•Six years of development finds this P-6 Hawk with greater horsepower—625—and many improvements.

1937•Retractable landing gear (a 1933 development on the Navy Hawks), a speed of over 300 m.p.h., a 1100-H.P. engine, were among the notable advances on the P-36 series.

1941•Since the production of the original P-40's, this famous series has undergone four successive "step-ups" to new high performance levels in speed, ceiling and striking power.

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AVRO LANCASTER

The Lancaster is characterised by underslung engines, a fairly thin wing, and twin rudders.

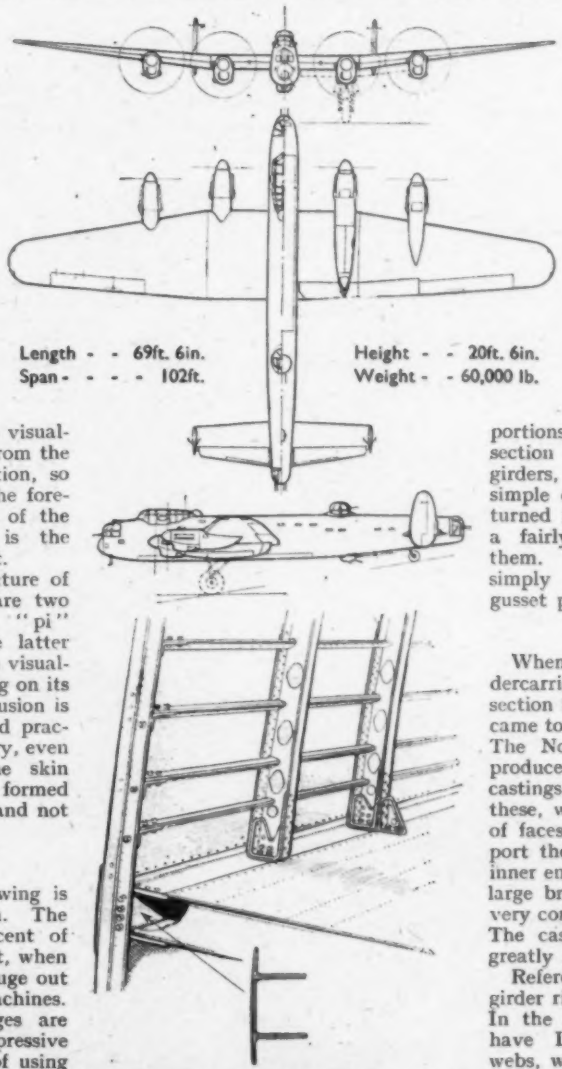
the British aircraft industry, has graduated to his present position through the hard school of works managership, and has retained his insistence upon the manufacturing aspect being kept prominently in mind during the design stage.

It would be fair to say that the Lancaster was virtually designed around a "chassis" formed by the bomb bay roof, the wing centre section, and the undercarriages. The floor is of great length to accommodate the bomb load, which may include the largest bomb visualised at present, and is slung from the spars of the wing centre section, so that these two frames form the fore-and-aft and transverse limbs of the cross-shaped chassis which is the backbone of the whole aircraft.

In its turn, the main structure of the roof of the bomb bay are two extruded double-channel or "pi" sections. If one adopts the latter name, the arrangement can be visualised as the Greek letter pi lying on its side (see sketches). This extrusion is a very fine piece of work, and practically no machining is necessary, even the shallow recesses for the skin plating of the fuselage being formed during the extrusion process, and not by subsequent machining.

The Centre Section

The centre section of the wing is of equally simple construction. The spars are, somehow, reminiscent of the old days of wooden aircraft, when it was common practice to gouge out the spar flanges on spindle machines. In the Lancaster these flanges are light alloy channels of impressive dimensions, and the manner of using them is interesting. Instead of placing the channel sections with their backs towards the wing covering, they lie on their sides, and the solid sheet spar web plating is riveted to the closed sides of the channels. It will be seen that this arrangement greatly facilitates the attachment (by bolting) of other structure members, equipment, etc.



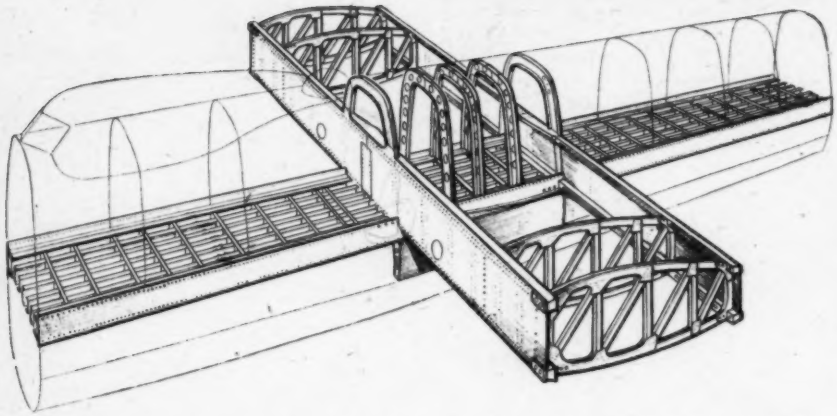
Fuselage construction and the "pi-section" longeron of the bomb bay.

The similarity to wood construction goes farther. The spar flange channels are routed out in much the same way, and the taper in the spar flanges from centre section to wing tips is obtained by milling away portions of the channel walls. Centre-section ribs are in the form of N-girders, the limbs of the N being simple channels, with the free edges turned inwards so that there is only a fairly narrow gap left between them. Such sections can be very simply joined together by plain gusset plates and rivets.

Use of Castings

When it came to attaching the undercarriages to the ends of the centre-section front spars the metal founders came to the aid of the Avro designers. The Northern Aluminium Company produced some rather remarkable castings in a new light alloy, and these, with a minimum of machining of faces for the pick-up points, support the undercarriage units and the inner engines. To have built up these large brackets would have entailed a very complicated and heavy structure. The castings are light and the job greatly simplified.

Reference has been made to the girder ribs of the wing centre section. In the outer wing portions the ribs have L-section flanges and sheet webs, with spanwise stringers bracing them laterally and stiffening the skin covering. The leading edge is a



The backbone of the Lancaster is formed by the centre-section spars and the roof of the bomb bay, which forms the floor of the fuselage.

separate unit, and is hinged along the top flange of the front spar so as to give access to the leads and equipment which are all carried along the front face of the spar, so that there are no encumbrances between the main spars except the fuel tanks and the retracted undercarriage units.

The fuel tanks in the wings (there are three on each side) are of the simplest construction imaginable. They are of oval section and made up from large flat sheets to which V-section stringers have been shot-welded. The sheets are then bent to the oval form desired, and the edges of top and bottom panels welded together. The oval form is maintained by internal baffles, the edges of which are spot-welded to the stringers. Only the tank ends require any forming, and they are welded to the tank body (see sketch). These tanks have proved extremely light and have never given trouble in service. The usual leak-proofing is, of course, applied.

Undercarriage Retraction

The undercarriage units have Dowty shock-absorber struts, and retraction is rearward in the usual way, by a hydraulic jack operating the "broken" rear struts. The wheels and tyres are Dunlops, and the tailwheel is non-retracting, carried on a Dowty shock-absorber strut.

Fuselage construction is of the usual type, with channel-section formers and Vee-section stringers, notched into the formers. The fuselage is of good streamline form, with deeply curved top and bottom and slightly curved sides, which latter have a slight "tumble-home" (in a boat this expression means that the beam at the deck is less than that at the load waterline).

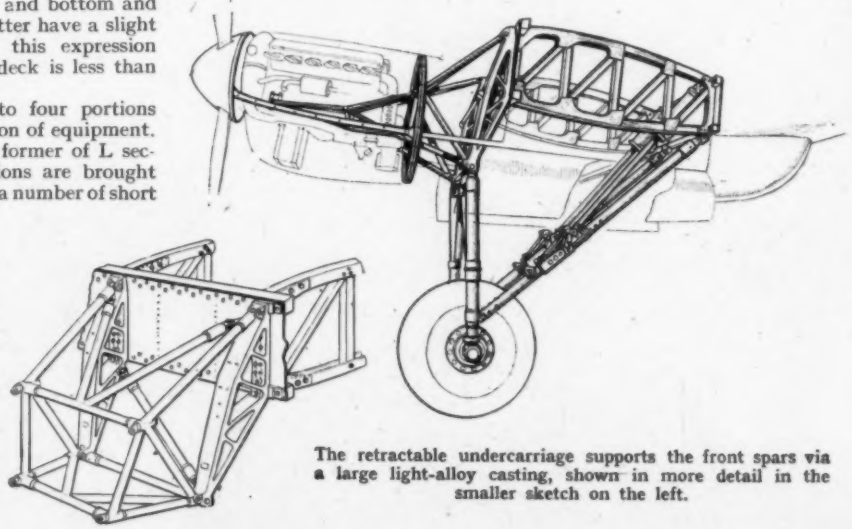
The fuselage is divided into four portions so as to facilitate the installation of equipment. Each portion terminates in a former of L section, so that when two portions are brought together they can be joined by a number of short bolts through the two rings. The stresses are carried into the stringers and skin plating by small forgings. Reference has already been made to the fuselage floor, which supports the bomb load, and is slung from the centre-section main spars.

An interesting feature of the Lancaster, which it does not share with other heavy bombers, is that the four Rolls-Royce Merlin engines are underslung. The obvious structural advantage of this is that the engine bearers are simply "buttoned" to the wing spars, and are not built into the wing structure. Not only does this greatly simplify the attachment of the engine bearers (the outboard engines are attached by three bolts only), but makes for ease of changing engines. Not only so, but engines of different type can be substituted with a minimum of structural alterations.

Mr. Chadwick claims another advantage for the underslung engine position, this time an aerodynamic one. Hitherto it has been held quite generally that the engine position with the airscrew in line with the leading edge of the wing gives the lowest drag. Mr. Chadwick's argument is that while this is probably so for top-speed conditions, it does not apply at larger angles, such as climbing and cruising. He holds that any obstruction on top of the wing is bound to cause a disturbance of the airflow, so that at the larger angles of incidence there is an earlier breakaway in the wake of such obstructions, leading to greater drag and ultimately to stalling.

Engine Fairing

It will be seen from the illustrations that in the Lancaster the tops of the engine nacelles are about on a level with the upper surface near the front spar, and that the two surfaces are carefully faired into one another. The very good performance of the Lancaster (not only top speed but climb and ceiling are exceptional) does seem to indicate that Mr. Chadwick is right, and that the underslung engine position does give low drag and good wing characteristics. The good rate of climb and the high ceiling of the machine (the two flight conditions in which induced drag is really important) cannot be ascribed to an exceptional aspect ratio, since that of the Lancaster is only about 8, which is not unusual in an aircraft of this class, and one is rather forced to the conclusion that there is something in the underslung engine arrangement. The fact that the wing



The retractable undercarriage supports the front spars via a large light-alloy casting, shown in more detail in the smaller sketch on the left.

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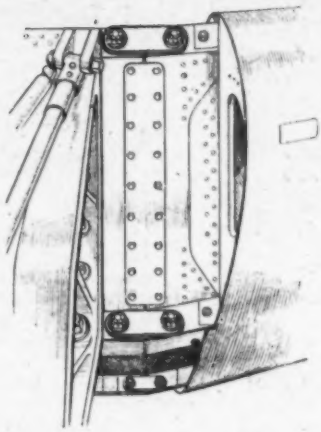
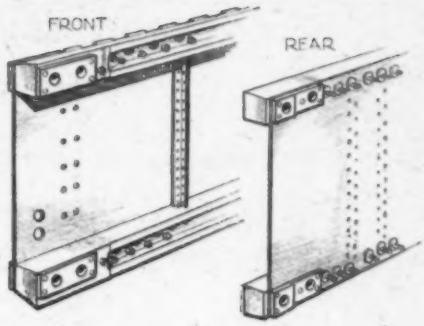
is set rather high on the fuselage probably also helps, and the use of a fairly thin wing section (18 per cent. at the root) must also be of material benefit.

Control surfaces of the Lancaster are of fairly orthodox design. The ailerons are fitted with balance tabs, and, in addition, the starboard aileron only has a trimming tab. The ailerons are fabric covered. The elevators have one balance tab and one trimming tab each, and are also fabric covered. In addition, the elevator is slightly unusual in that its primary structure includes very light ribs of steel. The rudders are metal clad and each has a trimming tab on the trailing edge. Horn balances at the lower end are used instead of tabs for the rudders. The fins are attached to the extreme ends of the tailplane.

Trailing-edge flaps of the plain split type are used, but their operation is interesting. A hydraulic jack is placed centrally in the fuselage, with its cylinder lying spanwise. Operating rods (actually tubes) run from the jack along the fixed portion of the wing, and from them at short intervals slope inwards and downwards short hinged links, the other ends of which are secured to the flaps. When the jack draws the operating tubes in towards the fuselage, the links are pushed downwards with a toggle action, and the flaps with them. For take-off the flaps are lowered about 30 degrees, and for landing they are, of course, right down. The Lancaster is, however, extremely docile, and pilots report that even a so-called balked landing (a landing during which an obstacle suddenly looms up ahead so that it becomes necessary to give full throttle and take off again) holds no terrors.



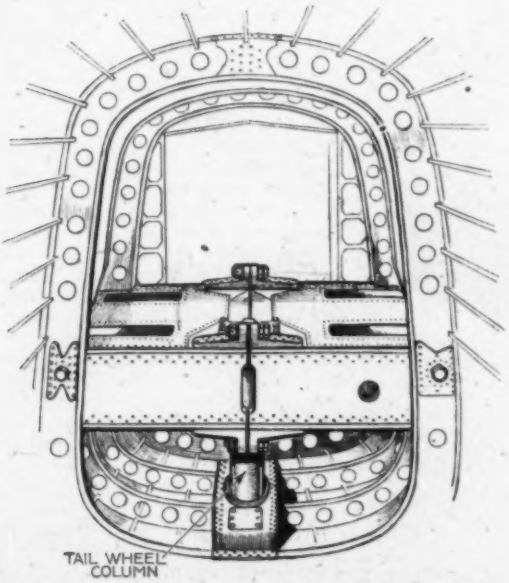


The outer ends of the centre-section spars. Note the very simple construction. The joint between centre-section and outer wing spars is shown on the left.

The dorsal turret of the Lancaster is, like the other turrets, of Frazer Nash design. It carries two Browning .303 machine guns.

The Internal Layout

Turning from the structure of the aircraft to the accommodation and equipment, the fuselage is entered through a door near the tail, on the starboard side. The ground clearance, even at the tail, is considerable, and for greater comfort a short ladder is used. This is stowed inside the door when not in use. The floor in the rear portion of the fuselage is level and straight, and there is ample headroom. The fact that the wing is set fairly high on the fuselage, and the depth of the bomb bay is very considerable, has resulted in rather scanty headroom in the region of the wing centre section. It is also a little difficult to step over the front spar, but once that has been negotiated and the forward part of the cabin reached, there is little stooping to do.



Mounting of the tailplane spars in the rear fuselage portion. The tail wheel does not retract.

The Lancaster differs from other four-engined bombers in that there are no dual controls. This is something of an innovation, but the operation of changing pilots is so quickly performed that there seems little reason for retaining the second set of controls, which always get in the way and also add a certain amount of weight.

Crew's Stations

As regards the layout, this is orthodox, with the nose gunner above the prone bomber's position below, followed by the pilot's cockpit, the navigator's cabin, and the wireless operator's position. These are all to port, with the gangway on the starboard side. The Frazer Nash power-operated gun turrets are in the usual positions (nose, tail, mid-upper and mid-lower). The crew is, however, smaller than normally carried in aircraft of this type, viz., six instead of seven. It consists of captain, second pilot, observer (navigator/bomb-aimer), two radio operator/air gunners, and an air gunner.

The flying controls are of normal type, with a wheel on a pillar for ailerons and elevators, and hanging pedals for the rudders. The pedal adjustment for leg length is extremely

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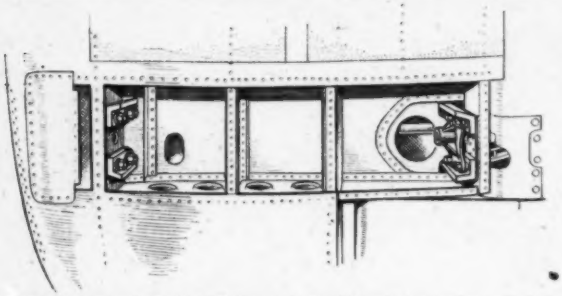
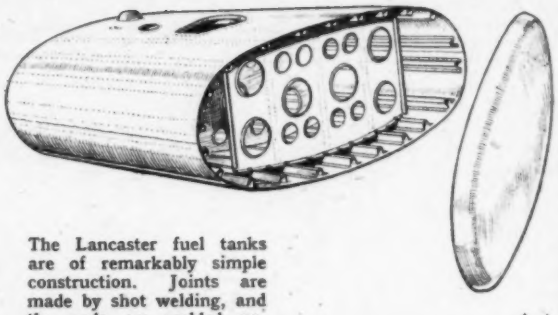
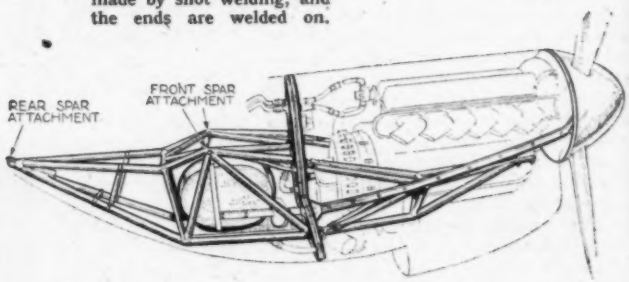


Attachment of fin to tailplane on the Avro Lancaster. A rudder hinge and portion of the horn balance can also be seen.



The Lancaster fuel tanks are of remarkably simple construction. Joints are made by shot welding, and the ends are welded on.



The outboard engines of the Lancaster are very simply supported from three pick-up points, two on the front spar and one on the rear.

simple and effective and can be operated by the feet. The elevator and rudder control leads are in the form of push-pull tubes, but the ailerons and the trimming tabs are operated by cables and chains over sprockets. Short lengths of chain are also used for the engine controls, and all backlash is eliminated by pre-tensioning the chains. Where it has been necessary the chains are twisted through an angle of 90 degrees. This is accomplished by inserting a small link in which the holes at the two ends are bored at the desired angle. Obviously, such an arrangement could not be used for continuous chains, but for the to and from motion of throttles and the like, the arrangement works well and is simple and positive.

Electrical Installation

The hydraulic, pneumatic and electric services are very neatly arranged, the leads running along the roof of the bomb bay, under the floor. There they are readily accessible, and altogether the Lancaster strikes one as being remarkably easy to service and maintain. Power for the hydraulic operation of the undercarriage units, wing flaps, bomb door jacks, and fuel jettisoning is obtained from a single pump in each of the inboard engine nacelles. Each of the four engines has a single pump for supplying power to each of the four gun turrets. On the port inboard engine is mounted an R.A.E. air compressor which operates the automatic pilot, and a Heywood compressor operates the pneumatic brakes and the radiator shutter system. Vacuum pumps on each of the inboard engines operate the gyroscopic instruments. Engine starting is electric, from ground accumulators or from the aircraft's own batteries. The electrical installation works on 24 volts, the power being supplied by two 1,500-watt generators, one in each inboard engine nacelle.

The fuel system is so arranged that the engines on each side are normally fed from the tanks on that side, but transfer pipe systems permit of feeding any engine from any tank. The tanks, by the way, have a total capacity of 2,154 gallons. The Merlin XX engines are pressure cooled and drive De Havilland constant-speed, fully feathering airscrews. The airscrews are provided with slinger rings for de-icing, and, in addition, equipment is installed for spraying de-icing fluid over the pilot's and bomb-aimer's windows.

A Lancastrian nose. The bomb-aimer's windscreen and optical flat, with the front gun turret (two .303 Brownings) and pilots' cockpit roof. Note how the underslung Rolls-Royce Merlin engines leave the upper wing surface clear.

Cabin Heating

The cabin heating arrangement is extremely simple. Branch pipes are taken from the cylinder jackets to a radiator in the leading edge. This radiator is placed in the middle of an air duct, one end of which is turned forward to the leading edge while the other enters the cabin wall opposite a baffle plate. In addition to the positive hot-air feed thus provided there is an extractor louvre on each side of the nose of the fuselage. By sucking air out of the cabin, these louvres assist the entry of the hot air.

A list of the equipment carried in the Lancaster would occupy a great deal of space, and in any case it is obviously very similar to that carried in other aircraft of the same class. There is, however, one item in the equipment, or rather the installation of it, which deserves special mention. The usual inflatable dinghy is, of

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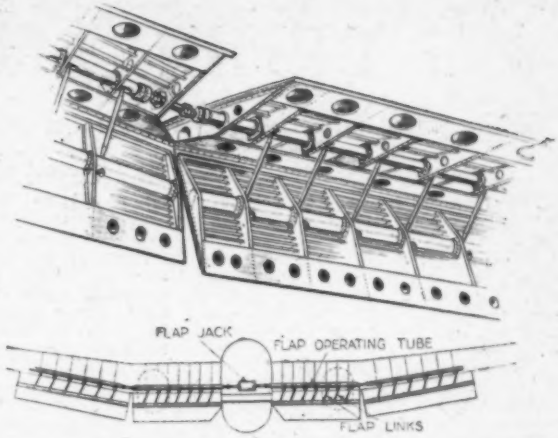
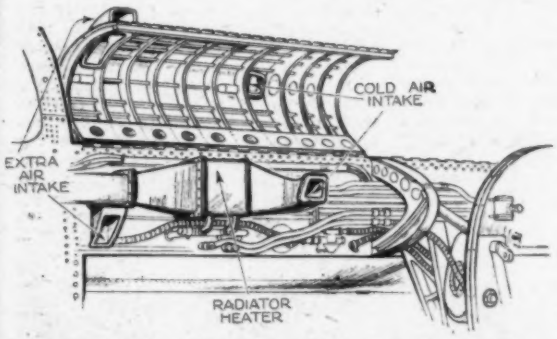
course, carried. It is stowed in the trailing-edge portion of the starboard wing, close to the fuselage, which is common practice. But its release can be effected from any part of the aircraft. A cable runs along the starboard wall of the cabin, with frequent breaks in the enclosing tube. At each of these points the cable is looped so that it comes readily to hand. The whole arrangement is very reminiscent of the emergency signals in railway coaches. For the case when it becomes necessary to release the dinghy from outside, there is an extension of the release cable which passes out through the fuselage wall, just aft of the cabin door on the starboard side, by the leading edge of the tailplane. Usually an aircraft floats in a nose-down attitude, and in most cases this point will be within reach of a man swimming in the sea or clinging to the tailplane. The usual automatic release is, of course, also provided.

The Lancaster is now in production in many factories of the Avro group and in those of other British aircraft firms. In addition, it is being produced on a large scale in one of Canada's biggest factories. In this connection it is fit and proper to pay tribute to those responsible for the design and production of the prototype, and to the thousands of workers who have since done their utmost to ensure that the output shall continue to grow at an ever-increasing rate.

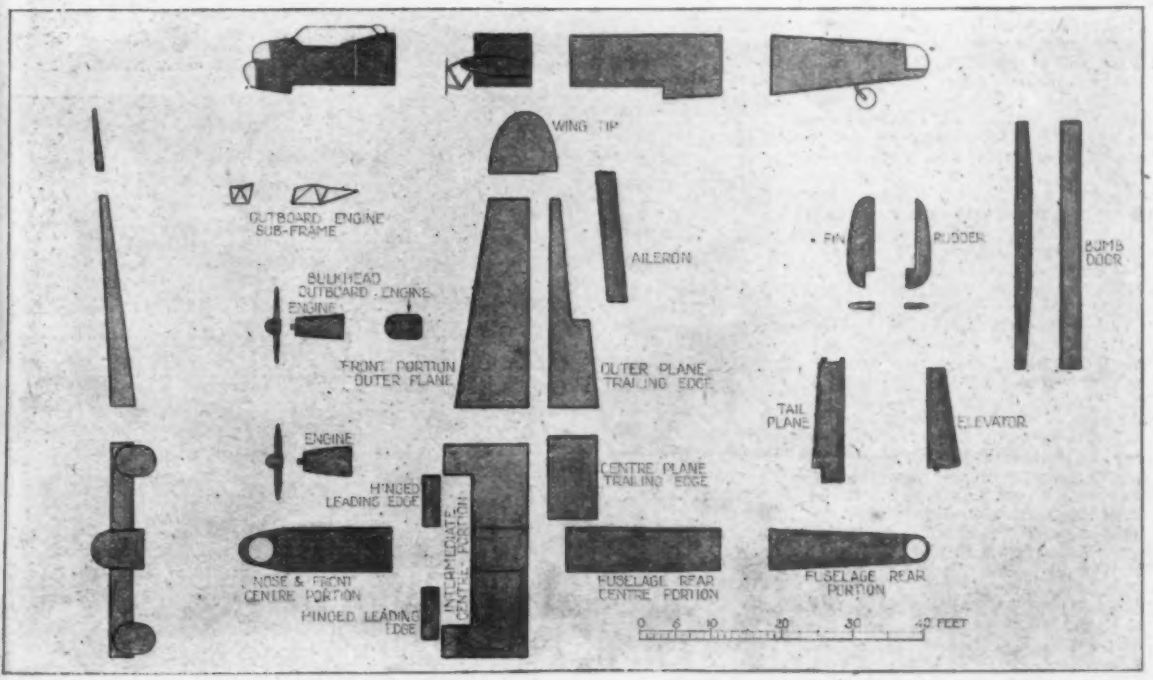
We have already mentioned Mr. Chadwick and Mr. Dobson. For producing the prototype in record time Mr. S. D. Davies and his team in the experimental shops deserve the very highest praise. When their job was finished Mr. C. E. Fielding, a director of the company and assistant general manager, took over the enormous task of planning and processing for quantity production. The Avro system of planning is exceptionally well arranged, and is such that any shortages of materials or parts come to light several weeks before these materials and parts are actually needed. The result is that hold-ups are rarely of a serious nature.



The split trailing-edge flaps are operated by a hydraulic jack and a toggle link mechanism.



The very simple cabin-heating arrangement. A radiator in the leading edge is supplied with hot water from the engine. Cold air enters the duct in the leading edge, is heated and passes into the cabin.



For production, installation and transport purposes the Avro Lancaster is "broken down" into units, as shown.

BEHIND THE LINES

Service and Industrial News from the Inside of Axis and Enemy-occupied Countries

Jap Air Service

IT is reported from Tokyo that the Japanese Government has organised an air service between Japan, Java, Sumatra and Borneo. Details of the service are not known, but neutral sources suggest that the service will be employed for the carriage of mail, military personnel and urgent supplies.

Patents in Japan

A SPECIAL order published in Japan deals with foreign patents. The order provides that Japanese firms are at liberty to exploit enemy patents registered in Japan, but in each case must procure a Government licence. A list of enemy patents registered in Japan has been compiled, and includes, among others, the synthetic rubber of Du Pont, electrical welding of Westinghouse, and different aeronautical patents taken out in Japan by British firms.

While the licence fees for other belligerent countries are paid to some official organisation acting as trustee for the enemy patent holder, no evidence is available as to the manner of payment contemplated by the Japs for the use of such American and British patents.

French Flying Boats

THE Potez-SCAN 161 six-engined flying boat has recently completed further flying tests. As reported previously, the aircraft was originally built for the French Government by the S.N.C.A. du Nord at their works at Sartrouville (formerly the Chentiers Aero-Maritimes de la Seine). The machine is reported to have developed excellent manœuvrability, and was airborne in 26 secs. The Potez-SCAN 161 has an empty weight, fully equipped, of 50,660lb., and a gross weight of 94,800lb. It is interesting to know that on one of the trial flights the machine was flown with ten occupants, and with a gross weight of 77,100lb. While the ultimate employment of the flying boat is not known yet, the swastika markings on its tail unit are explained as protection against German A.A. units.

Another flying boat type is the CAMS 140, produced by the same company, a model of which has been recently completed. As reported in *Flight* July 23rd ("Behind the Lines"), two flying boats, designated Látecoère 631 and powered with six Wright Cyclone air-cooled twin-row radials of 1,600 take-off h.p., are being completed.

The Breguet Works at Toulouse have been awarded a contract for the production of ten flying boats, presumably for the French Naval Air Service. The aircraft ordered are of the type Breguet 730, a four-engined patrol bomber flying boat, powered with Gnome-Rhone 14 N engines of about 1,000 h.p.

The new version will be designated Breguet 730-02. The same company is also reported to be contemplating the construction of another flying boat of a gross weight of 75 metric tons, with engines probably mounted in tandem, and fitted with contra-rotating airscrews.

Desert Emergency

SIMILAR to the rescue squadrons operating over the Channel area, the *Luftwaffe* is reported to have organised "Desert Emergency Squadrons." Announcing the formation of these squadrons, the German wireless says that their main purpose is to locate stranded units, forced-landed airmen, and to accord them the usual assistance.

Fiat Reports

THE Fiat Company is engaged on the development of new liquid-cooled aircraft engines, and new high-performance aircraft types. Test flights of the new types are expected to start shortly. A report on the activities of the Italian Fiat Aviation and Armaments Group given by Prof. Vittorio Valetta, the managing director of the company, points out that, despite longer working hours as compared with 1941, the personnel employed has increased to the present number of 76,000.

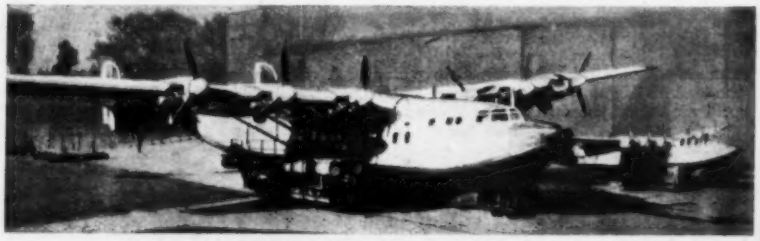
Particular emphasis is placed in this report on the expansion of plants and the benefits derived by the Italian company in their close collaboration with the German industry. It is to be assumed that this collaboration is mainly expressed by the production of German-designed power plants.

Nervous Hermann

A SIGNIFICANT order issued by Goering is in sharp contrast to the efforts of Nazi propaganda to minimise the effect of R.A.F. raids on Germany. It is stated that in view of the shortage of personnel for the A.R.P. and the incapacity of farming estates to cope with fires and damage resulting from R.A.F. raids, special measures of protection are necessary.

Detailed instructions are given about the equipment for fire fighting and rigorous enforcement of black-out is urged. The Nazis are particularly nervous about the danger of R.A.F. raids during the beginning of the harvest season, and Goering's order pays special attention to the necessity of organising precautions for farms during that period. Subject to their being mentally and physically fit "all members of the German community" in country areas are liable for immediate service with the civil defence.

Foreign workers and prisoners of war employed on farms are to be used for all A.R.P. duties, but not as spotters.



(Top) The Potez-SCAN 161 on its launching cradle ; the barrels beneath the platform are flotation gear. (Centre and bottom) The CAMS 140 which has fixed wing floats beneath its outermost engine nacelles and dihedral tailplane.

IN PARLIAMENT

Air Transport and Its Present Equipment : Efforts to Develop Torpedo Aircraft : Army's Control of Co-operation Squadrons : A.T.C. Staff Pay : M.A.P. Bomb Experiments

Transport Aircraft Development

Mr. Garro Jones asked the Prime Minister which Minister is responsible to the House for the proper development of air transport for war purposes?

Mr. Attlee: The Secretary of State for Air under the War Cabinet is responsible. The design, development and production of transport aircraft, to the specifications and requirements of the Secretary of State for Air, are, however, the responsibility of the Minister of Aircraft Production.

Mr. Garro Jones: Is my right hon. Friend aware that the record of the Air Ministry in the sphere of air transport, whether civil or military, is not an inspiring one, and will he, in view of the growing importance of this subject, ask the War Cabinet to apply some stimulus to that body on the lines of developments in the United States?

Mr. Attlee: I will consider that point.

Freight-carrying Services

Mr. Garro Jones asked the Secretary of State for Air (1) whether he has taken any steps for the establishment of air services for urgent war freights;

(2) whether any steps have been taken to utilise air-freight services on suitable routes?

Sir A. Sinclair: The answer to both questions is "Yes, Sir." Apart from transport services operated by the Royal Air Force, six freight-carrying services are at present operated from the United Kingdom by the British Overseas Airways Corporation, which also operates war transport services from other terminals.

Mr. Garro Jones: Is the right hon. Gentleman aware that the British Overseas Airways Corporation do not operate more than about 100 half-obsolete aircraft, and does this represent his conception of the importance of air-freight services at the present time?

Sir A. Sinclair: I cannot accept my hon. and gallant Friend's description of the aircraft with which these services are operated, but we are doing our best to make the operation of these services as efficient as we can with the resources at our disposal.

Mr. Garro Jones: Can my right hon. Friend deny that the British Overseas Airways Corporation operate about 100 aircraft, a great proportion of which are obsolete, and, I repeat, does that represent his conception of the importance of these services?

Sir A. Sinclair: I neither deny nor confirm it, because all these services are war services, and it would be most unfortunate to discuss in this House the number of aircraft.

Torpedo-Carrying Aircraft

Captain Plugge asked the Prime Minister whether he is now satisfied with the use and number of land-borne torpedo-carrying aircraft, especially in home waters?

Mr. Attlee: I would hesitate to express complete satisfaction with the scale of our equipment or the use we make of it in any branch of the Fighting Services, but I can assure my hon. and gallant Friend that no effort is being spared to develop the production of these aircraft and to improve their tactical employment. My right hon. Friend the Prime Minister would like to have more if that could be achieved without detriment to other interests.

Captain Plugge: Are the land-borne torpedo-carrying planes operated by the Fleet Air Arm, and are they the property of the Fleet Air Arm, or are they under the Royal Air Force?

Mr. Attlee: I should like to see that question on the Paper.

Captain Plugge: When will the Fleet Air Arm be granted the same freedom of action and of expansion as the Royal Naval Air Service enjoyed during the last war?

Rear-Admiral Beamish: Are the torpedoes carried by these planes provided, looked after, and tested by the Admiralty personnel?

Mr. Attlee: Perhaps the hon. and gallant Gentleman will put that question to the First Lord of the Admiralty.

Army Co-operation Command

Major C. S. Taylor asked the Prime Minister whether he will consider transferring both the command and the effective operational control of Army Co-operation Command to the Army?

Mr. Attlee: The Army already exercises effective operational control over the squadrons in Army Co-operation Command. My right hon. Friend the Prime Minister does not consider that any change in the present system of command is necessary.

Major Taylor: Is it not a fact that I received a reply to a Question that Army Co-operation Command is under the command of an Air Force officer?

Mr. Attlee: That is quite true. The hon. and gallant Gentleman asked me a Question, and I gave the reply referred to.

Major Taylor: How can the effective operational control of the Army Co-operation Command be in the hands of the Army if it is commanded by an Air Force officer?

Mr. Attlee: It is under his operational control.

Aircraft Production

Mr. Lipson asked the Minister of Aircraft Production whether he will enquire into the rents paid by aircraft firms for houses and other buildings which they have taken over; and where, as in the instance sent him by the hon. Member for Cheltenham, a rent of £550 a year is being paid for a house which the owner bought a few months ago for £2,000, will he have the rents revised to an amount considered reasonable by the district valuer?

The Minister for Aircraft Production (Col. Llewellin): When we find that a contractor is paying an excessive rent, we take steps to ensure that only a fair rent is reflected in the contract price. I am enquiring into the particular case mentioned by my hon. Friend.

Mr. Lipson: Would it not be possible to find out in the normal way what rent is being paid without considering the contract cost and asking them to have a check-up, as a great many of these excessive rents are being charged?

Col. Llewellin: It only concerns my Department when we are paying any part of them, and when we are doing that, enquiries are made and it is not allowed, as I told my hon. Friend.

Mr. Lipson: Can my right hon. and gallant Friend say who is concerned, as ultimately the taxpayer has to pay this and the Departments apparently do not mind what rents they pay?

Col. Llewellin: It sounds to me more like the Chancellor of the Exchequer.

Self-propelled Bombs

Cdr. Locker-Lampson asked the Minister of Aircraft Production whether his technical departments are still experimenting with self-propelled bombs; and whether inventions connected with this principle continue to be encouraged.

The Minister of Aircraft Production (Col. Llewellin): It would not be in the public interest to give this information.

Cdr. Locker-Lampson: May I ask that my right hon. and gallant friend should not forget this important issue?

Col. Llewellin: My hon. and gallant friend can rest assured that I shall not.

Air Training Corps Staff

Mr. Kenneth Lindsay asked the Secretary of State for Air the total strength of the staff employed full-time, both at headquarters and in the regional areas, in running the Air Training Corps; and what is the annual budget?

Sir A. Sinclair: The total full-time staff is 199, of whom 20 are employed in the Air Ministry and 98 at the headquarters of the Corps and 81 elsewhere. The total annual cost of their pay and allowances is about £63,000.

Northern Ireland Security Police

Dr. Little asked the Secretary of State for Air whether all the secret and confidential documents were collected from the Northern Ireland Royal Air Force Security Police prior to their discharge, and whether he will order a public enquiry, with power to take guidance on oath, to be held into the whole question of their dismissal.

Sir A. Sinclair: I am advised that no secret or confidential documents were issued to these men who, in any event, were ordered to hand over all official documents when they were discharged. As regards the second part of the question, the facts are well established and an enquiry would serve no useful purpose.

Dr. Little: Will my right hon. Friend consider the desire of these men for an enquiry, so that their case can be thoroughly investigated and the public may know exactly what is the position, as they do not understand the position of these men, and the matter ought to be cleared up?

Sir A. Sinclair: I cannot agree with my hon Friend. I do not think that there is the slightest misunderstanding about the facts, which are perfectly well known.

FOCKE-WULF Fw.190

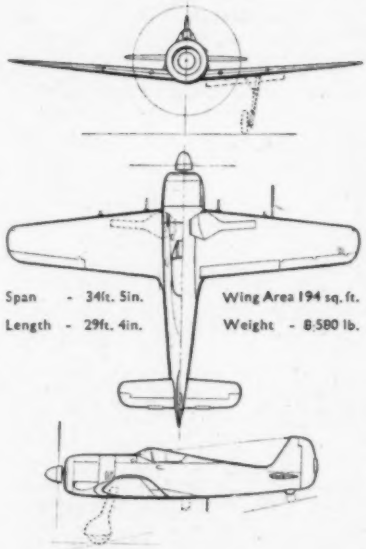
Features of the Design of Germany's Latest Single-seater Fighter

Clean Lines and Compact Power-unit : Novel Tail-wheel Retraction

FOCKE-WULF Fw.190/A3, the *Luftwaffe's* latest and much advertised fighter, presumably came first into service in September, 1941. At that time R.A.F. fighter pilots shot down two enemy fighters which could not be identified, and it is quite likely that they were two specimens of the Fw.190. On April 24th, a German broadcast from Oslo for German troops stationed in Norway officially announced the existence of the new fighter. On the same day pictures of the aircraft were released in Berlin and a rather ambiguous and enthusiastic statement was issued for home consumption. To start with, however, the *Luftwaffe* employed the Fw.190 in a rather cautious manner, avoiding trips over this country and limiting its operations to Northern France. Only lately has this aircraft come into wider employment.

A number of Fw.190's have been shot down by R.A.F. fighters in various combats. Recently an Fw.190 was intercepted over the Channel, damaged by our fighters and driven down on the South Coast of England with petrol and ammunition supply exhausted.

By courtesy of the authorities, *Flight* had the opportunity to inspect the machine at close quarters and to witness a demonstration of its flying qualities.

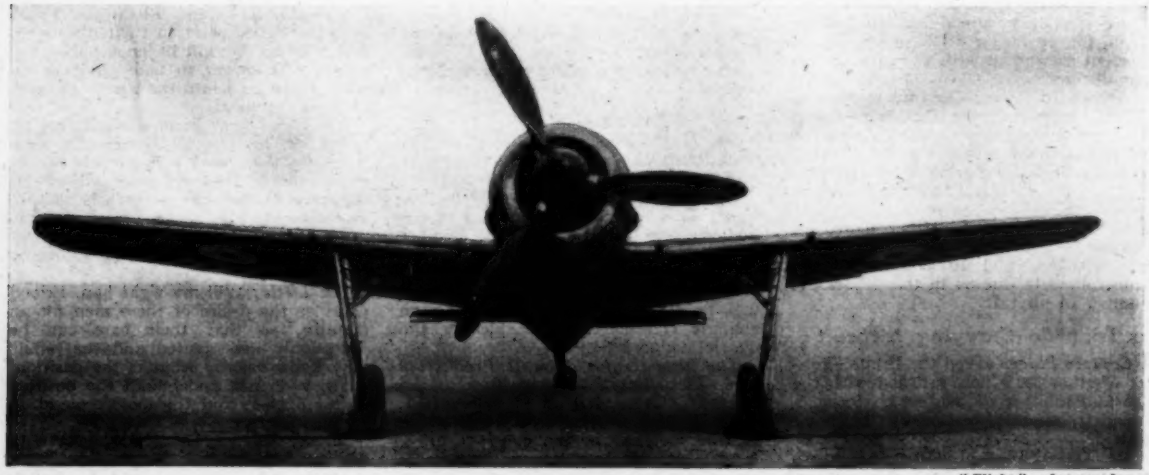


Design Details

As reported in *Flight*, May 14th, 1942, the Fw.190 was designed by the "Armaments Industry Leader" (Wehrwirtschaftsfuehrer) Kurt Tank, the creator of the Focke-Wulf Condor and of the short-range reconnaissance aircraft Fw.189.

The Fw.190 is a low-wing cantilever monoplane with a wing span of 34ft. 5in. and a length of 29ft. 4in. Normal flying weight is 8,580 lb. Wing-loading 42.3 lb./sq. ft. It is powered with a B.M.W. 801D 14-cylinder twin-row radial engine of 1,700 h.p. at 18,000ft. Power-loading is 5.2 lb./h.p.

The compact arrangements of the



"Flight" photograph.

Having learnt from experience with the Me 109, the Fw.190 has an exceptionally wide undercarriage. Fr m this front view it is apparent that the two Mauser inner wing cannons are synchronised to fire through the airscrew disc.

"Flight" photographs.

(Top) A three-quarter rear view of the Fw. 190 showing how the cockpit covering and fairing slide back in one piece. Below is a three-quarter front view which emphasises the high stilted appearance of the undercarriage legs. The inner piece of cowling has to open to allow the wheel to pass.

twin-row radial engine and the reduction in engine cowling to a minimum have given the fighter a power-output which stands in a favourable ratio to the dimensions of the aircraft. This feature can be considered an important advance in the design of fighters equipped with radial engines. A detailed description of the B.M.W. 801A is given elsewhere in this issue, but some of the differences between the two versions are worth noting. The cooling ring is fixed on the Fw.190 (not so on the Do.217) and the exhaust baffling is different from the B.M.W. 801A version. Incidentally, the opportunity has been seized to obtain full ejector effect from the exhausts but the existing shape of baffles, which do not provide for flame damping, makes the aircraft unsuitable for employment as a night fighter. The three-bladed airscrew of 10½ft. diameter has an exceptional blade-chord of 12½in.

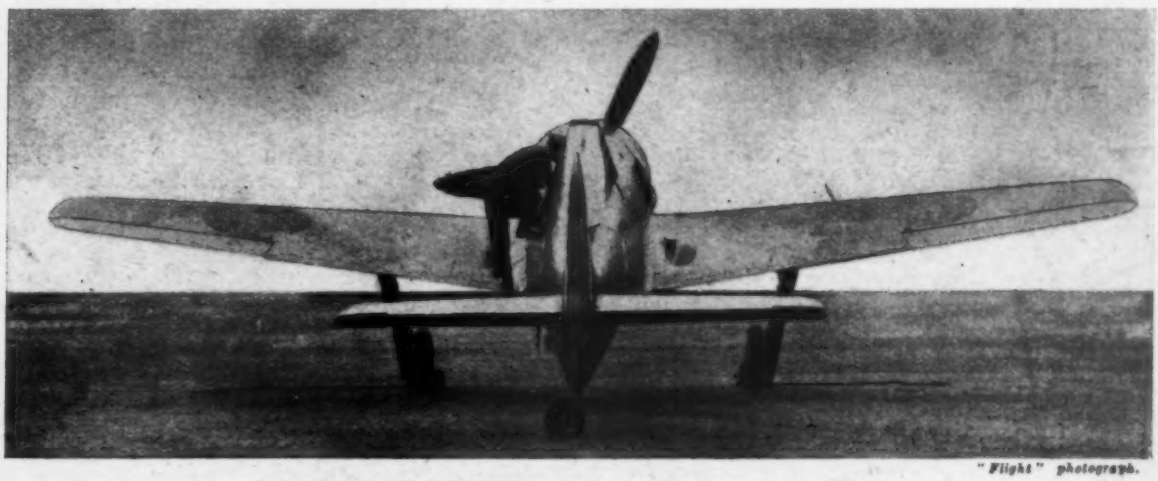
The object of the designer was to produce as aerodynamically clean a fighter as possible, and this has been achieved with a considerable measure of success. In fact, perhaps the most striking feature of the aircraft is the complete absence of any excrescences and the cutting down of drag to the absolute minimum. The aircraft does not display the "tubby" appearance of some fighters powered with radial engines but has rather a slim appearance with the fuselage slightly flattened on the sides. The clean effect has been produced by the reduction of the long-chord engine-cowling diameter to a minimum (52in.) and by fairing it smoothly into the lines of the fuselage.

The wings are of a somewhat rectangular appearance, with the leading and trailing edges almost parallel to each other but the leading edge slightly more tapered. Wing tips are rather angular but slightly backswept and more rounded than on the Messerschmitt type. The wing area is 194 sq. ft. (185 sq. ft. Me.109F).

Three Flap Positions

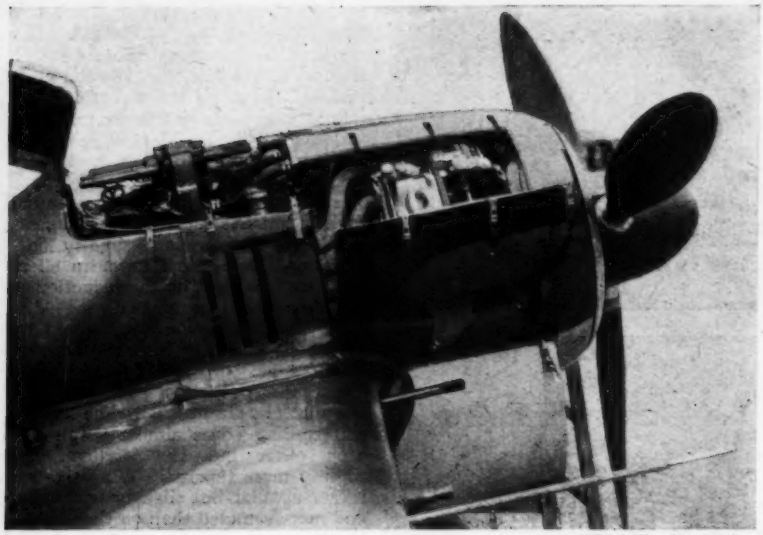
Three electrically operated buttons control flaps, which are adjustable to three positions, viz., up, to 10 deg. and to 60 deg. The tailplane is of cantilever type, slightly tapered and with a fairly high aspect ratio. The aerial is suspended between a kink on the fin and a spool on the cockpit cover, expanding or retracting according to the position of the sliding cockpit cover. Another short aerial is mounted beneath the fuselage, well back in the rear.

The manner in which the undercarriage is placed shows that the Germans have learned a lesson from the past employment of their fighters: in contrast to previous *Luftwaffe* fighters the undercarriage of the Fw.190 is of wide track. It is slightly tilted and retracts inwardly in the wings. The tail wheel retracts by means of a cable connection with the electrically operated undercarriage. The fairing plates



"Flight" photograph.

Rear view of the Focke Wulf Fw. 190 which shows the excellent streamlining.



"Flight" photograph.

The close-cowled installation of the B.M.W.801D engine in the Fw.190. On top of the engine are two rifle calibre machine guns and the two starboard wing cannons can be seen in the foreground.

of the undercarriage wheels are of a rather uncommonly large diameter, and a pressure scale is marked on the upper part of the landing gear.

The cockpit is placed slightly elevated and is very compact. The angle at which the windscreen is mounted is not as steep as on the Me.109F, and visibility, while good in flight, is poor in taxying. The cockpit cover is made in one piece of laminated type transparent Plexiglas mounted on a cone-shaped frame, tapering to a point at the rear. There is no supporting vertical framework, and the entire cockpit cover is mounted on rails and slides backwards, similar to a sunshine roof on cars, by the turning of a handle in the cockpit. In emergency it can be quickly thrown overboard by pulling a trigger. In the closed position the cockpit cover admirably fits into the general lines of the fuselage and gives the pilot a wide field of vision in flight.

Master Control Unit

The back of the pilot's seat is protected by an armour plate of 8 mm. thickness. Another ¼in. armour plate is placed in the back of the pilot's head, and both are neatly formed to fit on to the curved shape of the cockpit cover.

Practically everything is electrically operated. An outstanding feature of the Fw.190 is the master control ("Kommandeur") unit which governs boost pressure, airscrew pitch (constant speeding), automatic engagement of supercharger, and control of mixture strength. This "mechanical box" not only relieves the pilot of many duties in the control of the engine, but provides against mishandling on his part. The value and attraction of a device of this character is considerable. For the elimination of error in handling the machine by inexperienced pilots and the reduction of the pilot's functions is in itself a saving of the vast sums spent on repairs and breakages which are due so often to inexperienced handling.

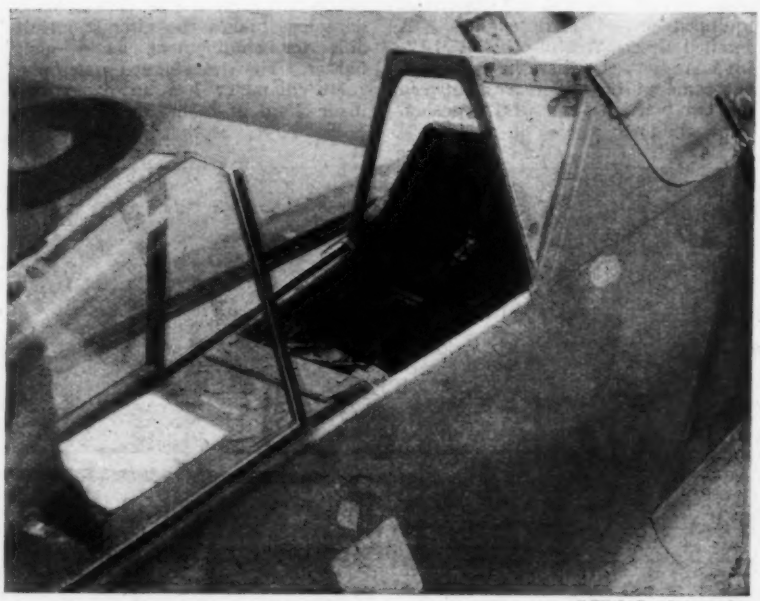
The armament of the Fw.190 is an indication of the new tendency of the *Luftwaffe* to increase the fire-power of their fighter aircraft. Compared with the Me.109F1, which mounts one 20 mm. Mauser cannon and two machine guns, or the Me.109F2, which has one 15 mm. Mauser cannon and two Rheinmetall-Borsig machine guns, the mixed armament on the Fw.190 is much more powerful. It is composed of four cannons and two machine guns in the following arrangement:—Two 20 mm. Oerlikon cannons are mounted in the wings furthermost from the fuselage and fire 450 rounds per minute outside the airscrew arc; two 20 mm. Mauser cannons outboard in the wings firing through the airscrew arc, and two Rheinmetall-Borsig 7.92 mm. machine guns mounted alongside and above the engine and firing 1,100 rounds per minute.. The Mauser cannon fires 950 rounds per minute, or about 850 with interrupter gear.

Bomb or Extra Fuel

All arms are electrically operated and there is an electrical detonator for cartridges. An interesting device is a disc automatically recording rounds fired. Although this is an interceptor fighter, for short-range operations one 550 lb. bomb can be carried underneath the fuselage, or alternatively a spare fuel tank fitted.

Two self-sealing tanks, one with a capacity of 292 litres, the other 232 litres, are fitted in the rear and in the cockpit floor, and both the oil tank and oil-cooler are armour covered.

A number of small and interesting items attract the attention of the onlooker: the clever metal clips locking the panels, which are as simple as locks on suitcases, the neat arrangement of the tail-wheel retraction gear, which is easily accessible; the "pressure buttons" which give quick access



"Flight" photograph.

Close-up of the cockpit showing how far the armour plate protection is behind the pilot's head. The front screen is bullet-proof.

Fw 190

to the inside of the fuselage, etc. Yet the practical value of these accessories designed to ensure rapid and easy maintenance is offset by other complicated arrangements on the aircraft.

While mass production methods appear to have been applied in the production of the fuselage and controls, undercarriage and wings, the aircraft features several devices which are likely to impede quick handling in repairs and maintenance. The master control box, an expensive and complex mechanism, is neither simply repaired nor maintained. The congested arrangement of the power plant makes it not only difficult for servicing but increases the vulnerability of the aircraft in combat, since serious defects are more likely to be produced by a hit in this crowded mechanism.

The performance of the Fw.190 is specially marked by the good rate of climb of the aircraft. At 4,000ft., and with the supercharger in low gear, it climbs at the rate of 3,050ft. per minute. In high gear and at 17,500ft. the rate of climb is 3,280ft. per minute.

Speed Capabilities

The speed at 4,500ft. with the supercharger in low gear is 326 m.p.h., and at 18,000ft. with the supercharger in high gear 375 m.p.h. The approach speed is in the region of 125 m.p.h., and stalling speed may be estimated at about 80 m.p.h.

To sum up, the Fw.190 is certainly a cleverly conceived and well-produced machine, embodying a number of improved features. In an attempt to assess its value as a fighter aircraft the favourable distribution of loads and the general aerodynamic features are particularly noteworthy. It cannot be doubted that the Fw.190 represents an important addition to the equipment of the *Luftwaffe*, but is far from being the "World's best fighter aircraft," which it is claimed to be by the Germans.

The qualities of the Fw.190 in operational flying are undeniable: it has complete manœuvrability, light controls and is quickly responsive. The good rate of climb and manœuvrability make it into an excellent instrument for evasive action, often necessary in face of better armed fighters.

"*Flight*" photograph.

Close-up of engine cowling and exhaust system. The engine cooling air passes through the louvres and serves to prevent exhaust fumes fouling the cockpit air.

(Left) The starboard undercarriage leg. The wire seen pivoted at the break of the operating strut passes through the body of the machine and draws the tail wheel up into the fuselage. (Right) The panel in the fin which gives access to the tail wheel retracting machanism.

Between 11,000 to 22,000ft. it may be classified as the best the Germans have yet achieved in the fighter class. Below and above these altitudes it is reported to be inferior to fighter aircraft now in service with the R.A.F.

Some Comparisons

The following data on other Axis fighters makes interesting comparison with that of the Fw.190.

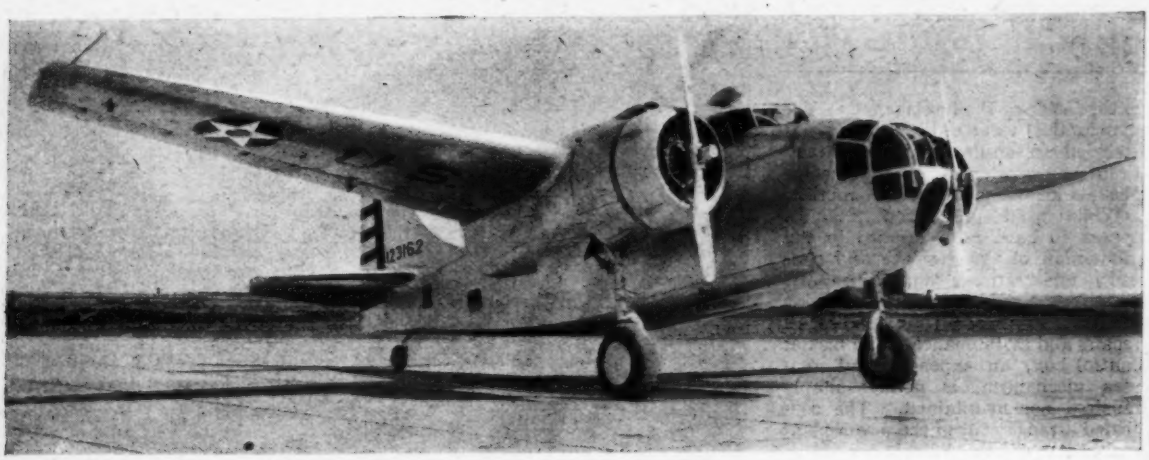
Me.109E: DB601A l.c. 12-cyl. engine, 1,150 h.p. for take-off. Wing loading, 31.4 lb./sq. ft. Power loading, 4.8 lb./h.p. Speed (max.), 354 m.p.h. at 12,300ft. Climb (initial), 3,100 ft./min. Armament, two 7.7 mm. m.gs. firing through the airscrew; two 20 mm. cannons in wings firing through the airscrew disc; one 1,210lb. bomb beneath fuselage.

Me.109F: DB601N l.c. 12-cyl. engine, 1,270 h.p. for take-off. Wing loading, 35.2 lb./sq. ft. Power loading, 5.6 lb./h.p. Top speed, 371 m.p.h. at 22,000ft. Climb, 3,320 ft./min. at 5,000ft. Armament, one 20 mm. or 15 mm. cannon; two 7.92 mm. m.gs. and one 1,210lb. bomb beneath fuselage.

Reggione Re.2000: Piaggio P.X.1 RC 40 a.c. engine of 1,000 h.p. at 13,120ft. Wing loading, 24.25 lb./sq. ft. Power loading, 5.7 lb./h.p. Top speed, 332 m.p.h. Climb, to 19,680ft. in 6 min. 10 sec. Armament, two large m.gs. fixed in fuselage; bomb racks under wings.

Macchi C.202: DB601N engine. Power loading, 6.1 lb./h.p. Top speed, 330 m.p.h. at 18,000ft. Armament, two 12.7 mm. m.gs. in fuselage and firing through the airscrew; two 7.7 mm. m.gs. in wings.

Macchi C.200: Fiat A 74RC38 a.c. engine with 870 h.p. for take-off at 2,520 r.p.m. Power loading, 7.1 lb./h.p. Top speed, 305 m.p.h. at 15,000ft. Armament, two 12.7 mm. m.gs. in fuselage, firing through airscrew; two 7.7 mm. m.gs. in wings.



THE BOEING AT-15 CREW-TRAINER : First training aircraft specifically designed and equipped for integrated tactical training of complete crews, the AT-15 is in reality a small bomber, complete even to bomb racks, power-operated gun turret, regulation bomb-aimer's position in the plastic-enclosed nose, and full radio and navigational installations. It is constructed largely of non-strategic materials. In place of the usual aluminium alloy or stainless steel, it is built mainly of wood, with some steel tubing used in the internal structure. It has a wing-span of approximately 59 feet and a length of 42 feet. Power is supplied by two Pratt and Whitney engines.

THE BOEING CREW-TRAINER

Wood and Fabric Largely Used in Its Construction

DELIVERY of the Boeing AT-15 Crew-Trainer to the American Army Air Forces for test was recently announced by the U.S. War Department. This new multi-engined aircraft, manufactured by the Boeing Airplane Company at one of its Middle West plants, is claimed to be the first training plane specifically designed and equipped for the integrated training of pilots, co-pilots, bomb-aimers, navigators and gun crews.

Its function is to give flight crews the training in co-ordination and teamwork so necessary before they take over tactical duties in multi-engined machines of this type. To provide the desired training facilities the aircraft is equipped with constant-speed airscrews, radio compass, automatic pilot, full complement of flight and radio equipment, flexible machine gun, flexible camera gun, power turret, and moderate capacity totally enclosed bomb racks.

Representing the last step in the student's advanced training period, provision has been made in the machine so that crew members may receive individual instruction as well as group training. Conservation of aluminium alloys and castings, all critical materials needed in production combat-type aircraft, was a prime consideration in the design of the AT-15.

Looking very much like a small twin-engined bomber, this crew trainer is constructed of steel tubing with wood-faired fabric covered fuselage and plywood covered wings and tail surfaces. Having a wing span of approximately 59 feet and a length of 42 feet, it has a top speed in excess of 200 miles an hour with its two Pratt and Whitney engines equipped with Hamilton Standard airscrews.

Americans "At Home"

AN American club for A.T.A. pilots, to go some way towards making American pilots feel "at home," was opened at Maidenhead on Saturday by Sir Edward Grigg, M.P., the chairman of the Hospitality Committee of the Foreign Office, who said he hoped the club would prosper as a symbol of the ties of friendship which united two great nations whose mutual co-operation was essential for the well-being of the civilised world in the future.

He also expressed his satisfaction and pleasure at the spontaneous nature of the many offers of assistance received by the Committee referred to in helping Americans during their sojourn on this side of the Atlantic. A Counsellor of the American Embassy responded on behalf of American personnel. A speech of welcome was also made by Commodore G. d'Erlanger, Officer Commanding A.T.A.

The club (formerly the Show Boat) is splendidly equipped and has a magnificent open-air swimming pool. It is to be known as the American Club.

Turbine Booster for Rockets

AN automatically detachable turbine and propeller assembly that would give rocket projectiles an initial boost of speed until they reach the substratosphere and then drop off to reduce the weight is the subject of a United States patent recently issued to Dr. Robert H. Goddard, who has conducted rocket research and experimentation for many years in the desert near Roswell, New Mexico.

The turbine assembly, according to the description, is attached to the rear of the rocket and is driven by the backward jet of burning bases ejected by the rocket. Propeller blades fastened to the turbine give forward thrust to the rocket in the relatively heavy atmosphere near the surface of the earth.

Release mechanism operated by reduction of air pressure automatically detaches the assembly when the rocket reaches the substratosphere, freeing the projectile of the weight and drag of the turbine and propeller and enabling gas-jet propulsion to drive it to greater altitudes, while a parachute floats the turbine assembly safely to earth.

New Eire Internal Service

THE first internal air line to be operated in Eire was opened between Dublin and Limerick yesterday by *Aer Lingus Teoranta* (Irish Airways, Ltd.).

The service will operate from the Dublin Municipal Airport at Collinstown to the Shannon Airport at Rhynanna and, apart from improving internal transport facilities in Eire which have become difficult owing to the shortage of fuel for railways, the route will provide a more efficient link with the transatlantic air services operating from the Shannon.

It is understood that the return fare between Dublin and Limerick will be £5.

"Flight" Index

FLIGHT index for January-June, 1942, is now available, price 7½d., post free, or with binding case, 4s. 4d.

Readers' copies can be bound at a cost of 12s. 9d., including postage, but owing to shortage of staff some delay in delivery may be experienced.

Correspondence

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers not necessarily for publication, must in all cases accompany letters.

TRANSPORT GLIDERS

Economic Possibilities in War

IN view of the latest American scare for giant transport planes, with the launching of the great boat *Mars*, might I suggest that the most obvious development of commercial aviation is the production or modification of existing planes to tow trains of giant gliders.

If an old type can tow gliders with fully equipped soldiers, how much easier should a modern transport plane, with, if necessary, some modification, be able to tow one or more huge gliders, themselves made in a fraction of the time and at a fraction of the cost of the towing plane?

It might even be possible, when high flying pattern bombing is resorted to, to utilise electrically controlled crewless gliders to multiply the load carried by the towing craft, which could always cut them adrift if they themselves ran into trouble.

The use of the glider as an auxiliary petrol tank would also make possible bombing raids over hitherto undreamt-of distances, and the possibility of giving Tokio a thorough plastering, as a regular routine job, would become a fact in a short time.

The glider itself, once its design had been frozen, would allow of the simplest form of mass production dear to the hearts of men like Mr. Henry Ford, and could also be made with detachable wings for easy stowage or transport, when necessary, by sea.

T. C. CLAIRE.

FUEL CONSERVATION

Risk of Slowing Production

I THINK your statement that "everyday and all day half a million horse-power is running to waste" is misleading. Nothing that does a useful job is wasted. Surely you mean that we might be eating our cake and yet keeping it.

I have in mind the case of the air-cooled engine. By far the greater part, I venture to say as much as 70 per cent., of production running to-day is carried out "on the hangar." Perhaps the chief reasons for this are reduction in man-hours per engine and reduction in complicated test mechanism required. The time is saved as skilled jobs such as fitting flywheels and lining up the test stand are eliminated and the absence of the wind fan, dynamometer, coolers, etc., with all their electrical equipment makes for much simplified maintenance and operation.

The most common forms of hold up on the test bed are electrical failures. To-day in certain places even tuning and altitude checks are carried out on hangar stands, which gives a good idea of the advantages gained in speed.

To convert these hangars to electric dynamometers would lead to a slowing down in production equivalent to running all tests on the existent dynamometer stands. It must also be remembered that a cooling fan and motor (500-1,000 h.p.) would be necessary which would seriously reduce the nett gain, and, indeed, reduce it out of all proportion unless baffles and a tight cowling were fitted. Therefore, quite apart from the structural issues at stake, there seems only a very small gain, if any, to be had at the expense of slowing down production permanently.

Now consider dynamometer testing, three-minute periods at various conditions, probably interlaced by periods at slow running and, finally, wound up by acceleration. I suggest that if one stood with a "hasler" in one hand and chronometer in the other and recorded the r.p.m. every minute for six hours on any busy production stand, set the results out as a graph and found the area with a planimeter, the average horse-power would be less than 5 per cent. of rated power. If electrical testing equipment has developed to a stage where it can take advantage of this erratic type of running, whilst maintaining accuracy and reliability, then I agree that all existing dynamometers should be converted to electric. Such a conversion might well result in a further utilisation of as much as 30 per cent. of the horse-power expended in the testing of air-cooled engines.

In the case of the liquid-cooled engine perhaps there is more scope to take advantage of endurance running. If so, more power to its elbow!

I do not wish to be classed as one of those who take it upon themselves to argue against all new and possibly progressive ideas. I feel sure that there are certain tests, such as type, series, mod. approval, etc., for which an electric dynamometer could be used to advantage, but at the same time the general run of aircraft engine testing, particularly now, is not one that lends itself readily to any retentive harness. This is a point which should be made clear if only out of fairness to the firms (one in particular) who have developed test equipment to its present high standard of accuracy.

R. P. G J.

BOOK REVIEWS

Spitfire Pilot. By Flight Lieutenant D. M. Crook, D.F.C. (Faber and Faber, 5s.)

IT has so happened that most of the books about air fighting in this war which have come to us for review have been about Hurricane squadrons. This book is a change because it is about Spitfires. Also it concerns one of the Auxiliary Air Force squadrons, No. 609, West Riding. The author was in the squadron before the war, and naturally had a great love for it, even though the original personnel gradually changed, and the officers' mess filled up with men who wore V.R. instead of A. on the lapels of their uniforms. The newcomers were not all Yorkshiremen, two were Poles, and the squadron recognised them as grand chaps and stout fighters.

The author was also devoted to his Spitfire, and found it a gloriously manœuvrable machine. He believes that he once dived it at 600 m.p.h.; it stood the strain and he did not quite black-out, though he had an awful pain in his ears. Then he polished off his Messerschmitt.

He admits that at first his squadron had much to learn about air fighting. It took some time before the pilots realised the great importance of height at the beginning of a scrap, diving out of the sunlight, etc., and also they were at first inclined to send up only three machines when it would have paid to send the whole squadron. In learning their lessons they lost too many good men; but gradually they mastered their business, and once during the Battle of Britain they gained chief place in the day's news by shooting down thirteen Germans near Portland in a very few minutes without loss to themselves.

The book is written in good, straightforward style, and it is hard to put it down until the last page has been reached.

Arise to Conquer. By Wing Commander Ian Gleed, D.F.C., with a foreword by Flight Lieutenant John Strachey. (Victor Gollancz, 8s. 6d. net.)

WING COMMANDER GLEED is a very gallant officer who has shot down many enemy aircraft and has been decorated by the King with the Distinguished Flying Cross. In common with all his countrymen we honour him. Here, however, it is our business to discuss his abilities as an author, and it is better to get adverse criticism over and done with first. He almost spoils his book by innumerable repetitions of the word "Hell," which first bore and then irritate the reader. Perhaps he remembers how effectively Mr. Bernard Shaw in *Pygmalion* uses an unparliamentary word *once*. This author may say that he is a fighter pilot, while Mr. Shaw is a professional writer. If so we would refer him to two books by other fighter pilots which rank as Literature (with a capital L):—*Sagittarius Rising*, by Cecil Lewis, late of No. 56 Squadron, and *Fighter Pilot*, by an officer of No. 1 Squadron who was with the A.A.S.F. In the former he may note with what biting effect Mr. Lewis once (and we think only once) uses the Pygmalion adjective. Senseless repetition robs expletives of all force.

Apart from this blemish, Wing Commander Gleed's book is a good one. He gives spirited descriptions of many air combats, and describes his own victories with modesty. In addition, he gives an excellent account of the daily life of a fighter squadron, first in France and afterwards in the Battle of Britain. The reader will readily understand how his pilots must have worshipped him, and all will wish him many more victories, more decorations, and a long and happy life.

Service Aviation

Royal Air Force and Fleet Air Arm News and Announcements

Officers Commanding U.S. Army Air Forces in Europe

Major General CARL SPAATZ, Commanding General, United States Army Air Force, European Theatre of Operations.

Major General W. H. FRANK, Commanding General, U.S. Air Service Command.

Brigadier General IRA C. BAKER, Commanding General, U.S. Bomber Command.

Brigadier General FRANK O'D. HUNTER, Commanding General, U.S. Fighter Command.

Brigadier General ROBERT C. CANDEE, Commanding General, U.S. Ground Air Support Command.

Brigadier General ASA N. DUNCAN, Chief of Staff, Army Air Forces, European Theatre of Operations.

Awards

THE KING has been graciously pleased to approve the following award in recognition of distinguished service in the Mediterranean:—

K.B.E. (MIL.).

Act. Air Vice-Marshal Hugh Pughe LLOYD, C.B., C.B.E., M.C., D.F.C.

Danzig Daylight Raid

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy:—

On July 11th, 1942, a force of bombers was detailed to make an attack on the submarine works at Danzig. The operation, which necessitated a high degree of skill and fortitude, was undertaken in extremely adverse weather. Despite this, the objective was reached by dusk, carefully identified, and, in the face of strong opposition from the ground defences, subjected to a most determined attack. Bombs were released at varying heights, some as low as 1,000 feet. Many hits were obtained. Searchlight posts were also machine-gunned and many searchlights extinguished. The success achieved reflects the greatest credit on the following personnel who participated in various capacities as leaders and members of aircraft crews:—

DISTINGUISHED SERVICE ORDER.

Sqn. Ldr. K. H. P. BEAUCHAMP, D.F.C., No. 207 Sqn.

Brigadier-General A. N. Duncan, Chief of Staff of the U.S. Army Air Forces in Europe.

DISTINGUISHED FLYING CROSS.

Sqn. Ldr. E. COTON, R.A.F.V.R., No. 97 Sqn.
Flt. Lt. S. E. PATTINSON, No. 207 Sqn.
Act. Flt. Lt. R. A. BODDINGTON, R.A.F.V.R., No. 97 Sqn.
F/O. I. McA. HUNTLEY-WOOD, R.A.F.V.R., No. 207 Sqn.
Act. F/O. M. E. DOBLE, R.A.F.V.R., No. 207 Sqn.
P/O. J. E. PARTRIDGE, R.A.F.V.R., No. 83 Sqn.

DISTINGUISHED FLYING MEDAL.

Flt. Sgt. G. APPLEYARD, No. 106 Sqn.
Flt. Sgt. D. G. BARNES, No. 207 Sqn.
Flt. Sgt. C. D. CALVERT, No. 83 Sqn.
Flt. Sgt. R. N. WILLIAMS, No. 83 Sqn.
Sgt. M. J. DARVILL, No. 106 Sqn.
Sgt. G. F. MCMAHON, No. 97 Sqn.

Air crews being interrogated on their return from the big Düsseldorf raid.

THE KING has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy:—

DISTINGUISHED SERVICE ORDER.

Wing Cdr. T. B. DE LA P. BERESFORD, D.F.C.—This officer continues to display skill and leadership of a high standard. He has led his wing in numerous sorties, many of which have been as escort to our bombers. One day in June, 1942, he intercepted a formation of enemy bombers and personally shot down one of them and shared in the destruction of another. The masterly leadership and keenness displayed by Wing Cdr. Beresford have set an example of the highest order.

Act. Wing Cdr. H. C. MAYERS, D.F.C., R.A.F.V.R.—Wing Cdr. Mayers has commanded a wing since April, 1942. He is an expert on bombing and machine-gun attacks, whilst his tactical knowledge has contributed much to the success of long-range fighter operations. On two occasions in May, 1942, this officer led a formation in attacks on aircraft bringing supplies to the enemy and destroyed many of them. Wing Cdr. Mayers has displayed gallantry and great devotion to duty in the direction of recent intensive operations.

BAR TO DISTINGUISHED FLYING CROSS.

Sqn. Ldr. O. V. HANBURY, D.F.C., R.A.F.V.R., No. 250 Sqn.—This officer continues to display outstanding skill, courage and fine leadership. Under his leadership his squadron has inflicted heavy losses on the enemy, both in air combat and on the ground. During a recent sortie he led a formation as escort to our bombers, far behind the enemy lines, and heavy damage was caused. All our bombers returned safely.

Major J. D. W. HUMAN, D.F.C., S.A.A.F., No. 1 (S.A.A.F.) Sqn.—This officer has completed a large number of operational sorties. He is an extremely efficient and reliable leader, whose work has proved most valuable. One day in May, 1942, whilst on patrol he sighted twelve enemy aircraft which he immediately engaged. During this combat he destroyed one enemy aircraft. Shortly afterwards, when acting as escort to our bombers, he encountered six Stukas accompanied by four fighters, which attacked our aircraft. On this occasion Major Human destroyed another enemy fighter. He has displayed courage and devotion to duty which have set an inspiring example.

Act. Sqn. Ldr. B. DRAKE, D.F.C., No. 112 Sqn.—Sqn. Ldr. Drake is a skilful pilot and a fine leader. He has displayed great energy and has led his squadron on every sortie in the latest battle of Libya. One day in June, 1942, an attack was made against Gazala airfield, which resulted in a number of enemy aircraft being destroyed or damaged on the ground. Sqn. Ldr. Drake has personally scored hits on enemy transport vehicles and on a heavy tank. In addition he has destroyed at least five enemy aircraft and damaged a number of others in air combats.

DISTINGUISHED FLYING CROSS.

Wing Cdr. H. A. FENTON.—This officer has led his wing successfully on many sorties. One day in May, 1942, he encountered 15 enemy bombers escorted by an equal number of fighters. Wing Cdr. Fenton, with two other pilots, immediately attacked the bombers and delivered four attacks before his own aircraft was hit by fire from an enemy fighter. Wing Cdr. Fenton's windscreen became covered in oil, but he was able to return to base, where he made a safe landing. This officer is a fine leader, who inspires much confidence in others.

Lt. Col. H. J. MARTIN, S.A.A.F., No. 12 (S.A.A.F.) Sqn.—This officer has led his squadron in many successful sorties. One day in June, 1942, he completed four separate attacks against the enemy, and, on the following day, he led his squadron in four further raids. He has displayed skill, fine leadership and complete disregard of danger.

Act. Sqn. Ldr. R. H. GIBBS, R.A.A.F., No. 3 (R.A.A.F.) Sqn.—This officer has displayed exceptional skill and gallantry in combat. One day in May, 1942, he encountered a large force of enemy bombers heavily escorted by fighters. Displaying great courage, he ignored the fighters and led an attack against the bombers. During the combat his aircraft was damaged, and he was forced to abandon it by parachute. Sqn. Ldr. Gibbs has completed a large number of operational flying hours in the Western Desert, and has destroyed six enemy aircraft and probably destroyed a further fourteen.

Major D. D. MOODIE, S.A.A.F., No. 4 (S.A.A.F.) Sqn.—This officer assumed command of

his squadron when our forces were withdrawing from Benghazi. Displaying great energy he has since led it on every sortie. In April, 1942, a courageous attack was made against 20 Stukas escorted by an equal number of fighters. Shortly afterwards he was the leader in an attack against at least 30 enemy fighters. He was reported missing from this operation, but returned later. His keenness, devotion to duty and masterly leadership have contributed largely to the successes which have been achieved.

Act. Wing Cdr. G. L. CRUICKSHANKS, No. 9 Sqn. (deceased), awarded with effect from 18.8.41. —On the night of July 1st, 1941, this officer participated in an attack on German warships at Brest. In the face of heavy anti-aircraft fire, Wing Cdr. Cruickshanks pressed home his attack. A photograph which he obtained during the action shows bombs straddling the dry dock in which one of the battleships was berthed. He carried out many operational missions over Germany. His leadership and determination were outstanding.

Sqn. Ldr. J. H. GRESWELL, No. 172 Sqn.—This captain of aircraft has at all times displayed high qualities of perseverance and enthusiasm in the performance of his duties. On one occasion he carried out a successful low level bombing attack on an enemy submarine.

Act. Sqn. Ldr. K. A. ALDRIDGE, No. 53 Sqn. —This officer has participated in active operations since April, 1940. He served in France, where he was injured as a result of enemy action. Following his recovery, he served as an instructor. Since rejoining the squadron, Sqn. Ldr. Aldridge has completed a large number of sorties, including night strikes against Brest and St. Nazaire. In May, 1941, he participated in an attack on a factory near St. Nazaire. Pressing home his attack with great courage, he succeeded in dropping his bombs in the centre of the target. One of the main chimneys disintegrated in the air.

Flt. Lt. E. S. S. NASH, No. 612 Sqn.—This officer has displayed great skill and devotion to duty in the performance of his operational tasks. In April, 1942, in bad weather, he was flying on convoy escort duty. His task was almost completed when he received a signal that one of the ships had lost contact with the convoy. He immediately undertook to search for the ship, knowing quite well that the additional flying would prove a drain on his petrol resources and jeopardise his prospects of flying the aircraft safely to base. Despite this, he carried out his purpose, located the vessel and passed to its commander information as to the bearing and position of the convoy. The weather had deteriorated considerably, but Flt. Lt. Nash flew on towards land and eventually landed safely at a strange airfield. Throughout, he displayed great determination. On another occasion, during an anti-submarine sweep, he was wounded in the hand and leg by enemy fire. His second pilot flew the aircraft back to base where, on arrival, Flt. Lt. Nash, although suffering severe pain, took over the controls and made a safe landing in darkness.

Flt. Lt. D. K. A. WORDSWORTH, No. 212 Sqn. (deceased), awarded with effect from October 22nd, 1941.—This officer carried out many operational missions, involving sorties over Norway, France, and in the Mediterranean zone. Throughout he showed continuous devotion to duty and courage. He destroyed one enemy aircraft, while he probably destroyed others during low flying attacks on enemy bases.

Act. Flt. Lt. D. A. BUCHAN, No. 59 Sqn (deceased), awarded with effect from Sept. 5th, 1941.—This officer carried out numerous operational missions. In July, 1941, he led a flight of nine Blenheims, escorted by fighters, on a daylight raid on the railway marshalling yards at Hazebrouck. Hits were scored on the railway yards and adjoining buildings. Much of the success of this operation can be attributed to the careful preparations made and tactics planned by Flt. Lt. Buchan before flight, together with his fine leadership and initiative during the attack. He always displayed great dash and enthusiasm, and he commanded his flight with marked success.

Act. Flt. Lt. T. B. HERD, R.A.F.V.R., No. 106 Sqn. (deceased), awarded with effect from Oct. 25th, 1941.—This officer carried out numerous operations over enemy territory, all of which were characterised by a daring and resource meriting the highest praise. He showed great determination to complete his allotted task, and many times, when hampered by poor visibility, spent more than an hour searching for his correct target; he often descended almost to ground level to machine-gun searchlights, gunposts or ships.

Act. Flt. Lt. C. J. MACKENZIE, A.A.F., No. 500 Sqn.—This officer has been engaged on operational flying since the war began. On one occasion he was captain and pilot of an aircraft engaged on an anti-submarine patrol. A U-boat was observed on the surface of the water some eight miles distant. Flt. Lt. Mackenzie skilfully approached his objective and, diving towards it, released his bombs across the forward part of the U-boat from a low level. This was followed by a machine-gun attack. The U-boat disappeared, stern first, leaving a large patch of frothy, brown water. This officer has at all times shown great courage, determination and devotion to duty.

Act. Flt. Lt. N. M. MAYNARD, No. 228 Sqn.— This officer has displayed great keenness for operations. He has recently been appointed captain of aircraft and has organised his crew to a high standard of efficiency. He has displayed great perseverance in searching out and attacking enemy submarines. These operations have reflected great credit both on the captain and the aircraft's crew.

F/O. A. F. H. TYE, R.N.Z.A.F., No. 269 Sqn.— This officer has completed his operational flying tasks, often in difficult weather. He is a skilful and fearless pilot who has executed three determined attacks on U-boats. On one occasion he made a successful landing at night on returning from an operational flight although one engine of his aircraft had ceased to function.

F/O. J. A. WHITECROSS, No. 80 Sqn (deceased), awarded with effect from July 27th, 1941.

Act. F/O. B. G. MCIVER, R.C.A.F., No. 106 Sqn. (deceased), awarded with effect from October 25th, 1941.

Flt. Lt. R. L. MCGREGOR, No. 298 Sqn.—In June, 1942, whilst on reconnaissance duties near Bir Hacheim, Flt. Lt. McGregor encountered four Me.109's which attacked separately. Displaying skilful airmanship, he accepted the challenge of each aircraft in turn and destroyed one. His own aircraft sustained severe damage. With the remaining three enemy fighters still pursuing him, he flew towards El Adem, where his aircraft crashed in flames. Flt. Lt. McGregor was uninjured and immediately proceeded to send in his report from the nearest telephone. This officer has displayed high courage and great devotion to duty in the face of the enemy.

Act. Flt. Lt. G. W. GARTON, R.A.F.V.R., No. 112 Sqn.—In June, 1942, when it became necessary to retire from a landing ground, Flt. Lt. Garton displayed considerable skill and initiative in salvaging a bomber which had been stripped of much of its equipment. Without having flown this type of aircraft previously, he successfully flew the bomber, with two passengers, to another airfield where he made a safe landing. Flt. Lt. Garton has participated in many operational sorties in which he has destroyed at least four hostile aircraft.

An American pilot in one of the Spitfires which the U.S. Army Air Force is operating with the R.A.F.

Wing Cdr. T. O. Freeman, D.S.O., D.F.C., R.N.Z.A.F. (No. 115 Sqn.), who has been awarded a bar to his D.F.C.

DISTINGUISHED FLYING MEDAL.

Flt. Sgt. D. H. MCBURNIE, R.A.A.F., No. 450 (R.A.A.F.) Sqn.—Flt. Sgt McBurnie has displayed outstanding courage and keenness in his combats with the enemy. He has participated in many operational sorties, and has destroyed several enemy aircraft. He particularly distinguished himself on one occasion when participating as cover to a formation of aircraft detailed to make a bombing attack. When nearing the target, the formation was attacked by two enemy fighters. In the ensuing combat Flt. Sgt. McBurnie displayed skill and determination and only broke off the engagement when his aircraft had been riddled with bullets and he was wounded in the leg and shoulder. This airman has set a fine example.

Flt. Sgt. D. G. REID, R.C.A.F., No. 185 Sqn.— This airman has displayed skill, courage and determination in the face of the enemy. On two occasions recently he has been detailed to attack enemy fighters escorting bombers, and although greatly outnumbered, he destroyed one fighter on each occasion. In June, 1942, he encountered a force of Italian bombers which were heavily escorted by fighter aircraft. Diving through the fighters, he attacked one of the bombers and set it on fire and then destroyed one of the fighters which had attacked him. Flt. Sgt. Reid has destroyed at least five enemy aircraft in a period of seven weeks.

Flt. Sgt. D. R. STEWART, R.N.Z.A.F., No. 70 Sqn.—One night in June, 1942, Flt. Sgt. Stewart was the captain of an aircraft detailed to attack enemy armoured vehicles and motor transport. After delivering several bombing attacks, he dived to a very low altitude and carried out two machine-gun attacks. Flt. Sgt. Stewart's aircraft was then hit by machine-gun and cannon fire from an enemy fighter. Displaying skilful airmanship, he evaded the attacker and, despite the severe damage sustained, flew the aircraft back to base, where he made a successful landing with the undercarriage retracted.

Sgt. G. F. BEURLING, No. 249 Sqn.—Sgt. Buerling has displayed great skill and courage in the face of the enemy. One day in July, 1942, he engaged a number of enemy fighters which were escorting a formation of Ju.88's and destroyed one fighter. Later, during the same day, he engaged ten enemy fighters and shot two of them down into the sea, bringing his total victories to eight.

Flt. Sgt. L. H. AUST, No. 59 Sqn.—This airman has been engaged on operational flying since May, 1940. He served in France and took part in several sorties whilst his squadron was based there. Since then he has completed many sorties throughout which his work as wireless operator/air gunner has been of a high standard. On two occasions, when his aircraft was intercepted by an enemy fighter, his well-directed fire drove off the attacker each time.

Sgt. S. E. GOULD, No. 230 Sqn. (deceased). Awarded with effect from July 29th, 1941.—This airman was first fitter/air gunner in a Sunderland aircraft which evacuated a large number of passengers from Greece between April 17th and May 2nd. His devotion to duty, which sometimes caused him to work 24 hours without a break, and his continual cheerfulness under adverse conditions were an inspiration to the rest of the crew. His keenness in his work, which entailed manning his gun and attending to the instruments during long flights, set a high example.

Sgt. H. MENARY, R.A.F.V.R., No. 22 Sqn. (de-

SERVICE AVIATION

ceased). Awarded with effect from August 12th, 1941.—In May, 1941, this airman carried out an attack on a convoy off the Frisian Islands in the face of heavy flak from the convoy and its escort. He selected a large-sized ship, which he sank after pressing home his attack. Sgt. Menary displayed great enthusiasm during the many operational flights he carried out, and his determination set a high standard.

Sgt. H. G. N. MORISON, No. 42 Sqn. (deceased). Awarded with effect from August 9th, 1941.—This airman has proved to be an outstanding operational pilot. He has executed successful bombing attacks against enemy shipping, pressing home his attacks with great determination on all occasions. Following one of these attacks he was intercepted by two Me. 109s, but Sgt. Morison manœuvred his aircraft so skilfully that his gunners were enabled to shoot down one of the attackers and drive the other away.—Further operations include a mine-laying mission in difficult weather conditions which entailed arduous flying to reach the exact area. In another sortie Sgt. Morison attacked an enemy submarine, straddling it with four bombs. This flight was closely followed by a bombing attack on an airfield in Norway, carried out from a low level. Throughout, he has displayed great determination.

Sgt. H. SELL, No. 106 Sqn. (deceased). Awarded with effect from Oct. 25, 1941.—During the many operational sorties in which Sgt. Sell took part as a wireless operator/air gunner he never experienced a failure. On several occasions this airman attacked successfully enemy searchlights and ground defences from a very low level. Sgt. Sell took part in attacks on Cologne, Kiel, Essen, Karlsruhe, Berlin, and in other operations. He displayed great coolness and courage.

Sgt. D. SILLS, R.A.F.V.R., No. 102 Sqn. (deceased). Awarded with effect from June 8th, 1941.—Sgt. Sills set an example that few can surpass. He was an outstanding wireless operator who maintained his equipment to the utmost pitch of efficiency under all conditions. By careful preparation on the ground and exceptional care and thoroughness in the air, he was largely responsible for the success of every sortie undertaken by his crew.

COMMENDATION.

THE KING has been graciously pleased to give orders for the publication of the name of the undermentioned airman in the London Gazette as having received an expression of Commendation for brave conduct in connection with Civil Defence:—

Flt Sgt. H P. B. BAKER.

R.A.F. Regiment

A/C.2 E. Lewis, of the R.A.F. Regiment, a native of Newfoundland, stationed at an Army Co-operation Command airfield, has been commended by Air Marshal Sir Arthur Barratt, the Air Officer Commanding, for an act of great bravery.

Lewis was on the airfield, watching a Blenheim bomber take off. Shortly after being airborne, the machine crashed and immediately burst into flames. Without any hesitation, Lewis rushed towards the burning wreckage, and made every possible endeavour to rescue the pilot. He went through the flames, and over ammunition which had started to explode. Although his face was badly burnt, he continued in his efforts to extricate the pilot, until he was forcibly restrained from doing so by other airmen, who realised that the pilot could not possibly be alive.

The A.O.C.-in-C. has directed that Lewis's fine example to his colleagues shall be entered on his service record-sheet, and brought to the notice of all ranks in the Command.

Roll of Honour

THE Air Ministry regrets to announce the following casualties on various dates. The next-of-kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational casualties, fatal accidents and natural deaths.

Royal Air Force

KILLED IN ACTION.—Flt. Sgt. W. D. Ashley; Sgt. K. A. Birch; Sgt. D. Boyce; Sgt. T. W. Chaston; Sgt. P. B. Crossan; Sgt. E. E. Eglinton; Sgt. T. Hanley; P/O. D. G. Hunter-Blair; Sgt. G. H. Jordan; Sgt. A. H. Lee; P/O. N. C. Lerwill; Sgt. L. S. Matthews; P/O. H. A. Milburn; Act. Flt. Lt. P. D. Moriarty; Sgt. R. D. Smith; Sgt. S. D. Stewart; Sgt. H. J. Thorogood; Sgt. A. E. Timberlake; P/O. E. M. T. Tremlett; Sqn. Ldr. J. H. G. Walker.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O E. E. Steele.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. F. R. Emery; F/O J. B. Hatchwell; Sgt. A. McLevy; F/O A. T. Read; Act. Flt. Lt. J. E. Slade.

WOUNDED OR INJURED IN ACTION.—P/O P. M. Beecnecnet; Sgt. L. D. Brigden; P/O. C. B. Brown; F/O. R. M. Chatfield; P/O. F. G. Davy; P/O. F. G. Gibbs; P/O. A. J. Hay; Flt. Lt. B. H. A. Playford; Act. Flt. Lt. T. P. K. Scade; Flt. Lt. A. J. Simpson; P/O. T. J. Thomas.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Sgt. K. A. Johnson; P/O. R. L. Pewitt.

MISSING. BELIEVED KILLED IN ACTION.—Act. Flt. Lt. W. D. Castello, D.F.C.; Sgt. M. Deighton; Sgt. T. J. Delaney; Sgt. O. F. Docherty; Sgt. S. Goldsmith; Sgt. A. S. Hatton; Sgt. R. S. Jones; Sgt. D. P. G. Kent; Sgt. R. E. Newton; Sgt. T. A. Stott; Flt. Lt. D. P. Wade; Sgt. D. S. Williams.

MISSING. — P/O. P. Anderson; Sgt. E. J. Andrews; Sgt. G. Baker; Flt. Sgt. E. B. Baxter; P/O. F. J. Blackwood; W/O. L. C. Bonathan; P/O. S. F. Brooker; P/O. J. G. Brown; Sgt. J. D. Burnley; Sgt. C. R. Campbell; P/O. J. R. Connolly; Sgt. E. A. Corderoy; Sgt. A. J. Currie; L.A/C. A. B. Durrant; Sgt. J. G. Fogarty; Sgt. A. R. Freeman; Sgt. W. D. R. George; Act. F/O. A. Gerrie; Sgt. G. W. J. Hadgraft; P/O. A. R. Heaton; P/O. T. Hindle; Sgt. A. J. V. Holman; Flt. Sgt. E. W. Jackson; Sgt. H. R. Jones; Sgt. S. D. Jones; Sgt. C. H. Johnston; Flt. Sgt. F. H. Jordan; Sgt. R. Kitchen; Flt. Sgt. H. J. Lambeth; Flt. Sgt. L. Law; Sgt. B. H. Leek; Sgt. J. Leeser; Sgt. K. Leyshon; Sgt. W. E. Lindsell; Sgt. D. H. McDonald; Sgt. I. McLaren; Sgt. J. Mercer; Sgt. T. J. Naish; Flt. Sgt. E. W. Noble; P/O. H. P. Palmer; Sgt. S. F. Parker; F/O. G. K. Parkes; Sgt. N. J. Patton; P/O. H. A. F. Peall; F/O. H. C. Pearce; P/O P. Pearson; Sgt. A. Pope; Sgt. R. P. Reilly; Flt. Lt. R. R. Sandford; P/O. R. M. Shattock; Sgt. F. W. Slingo; Sgt. S. K. Springham; Sgt. M. C. F. Swain; Sgt. A. A. Tearman; P/O. V. E. Tucker; Sgt. P. J. Venter; Sgt. G. H. Walker; Flt. Sgt. W. N. Ward; Sgt. R. W. Watson; Sgt. R. J. Nebley; Flt. Sgt. T. E. Willey; Sgt. R. E. Wing.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE. Cpl. M. Spence

KILLED ON ACTIVE SERVICE.—Sgt. C. W. Allen; Sgt. K. Ball; P/O. R. G. Beard; P/O. W. R. Bradley; Sgt. K. S. Cornwell; Sgt. J. Coward; Sgt. T. L. Dalton; Sgt. G. B. Gillan; Flt. Lt. G. Grant-Goran; P/O. F. R. Gregory; Sgt. N. Grimoldby; Sgt. C. F. Gunn; Cpl. K. W. Hayter; Flt. Lt. A. B. Hutchison; L.A/C. J. Livesey; P/O. T. Lundholm; Act. Sqn. Ldr. J. E. Marshall, D.F.C.; A/C.2 H. G. Medhurst; Sgt. H. Mills; Sgt. K. O'Connelley; F/O. R. Parr, A.F.M.; P/O. J. T. Parrott; P/O. M. H. Penney; Sgt. J. S. Roberts; Flt. Lt. H. N. Ross; P/O. C. D. Rutherford; Sgt. J. M. Smith; Flt. Lt. A. Strugnell; Sgt. K. H. Sutton; Sgt. P. L. N. Trcheam; P/O. J. F. Wemyss-Smith; Act. Flt. Lt. H. M. Williams.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Flt. Lt. I. L. B. Aitkens; L.A/C. F. E. Alderton; A/C.1 S. K. Chadwick; P/O. P. B. L. Falk; F/O. C. Gregory; L.A/C. S. T. James; L.A/C. G. H. Newson; Act. Cpl. E. E. Potter; A/C.1 F. Ratcliffe; L.A/C. J. A. Rees; L.A/C. E. Slack; A/C.2 E. Smith; Sgt. P. W. B. Timms; Cpl. R. L. West.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—P/O. K. Case; Cpl. A. F. Topham.

DIED ON ACTIVE SERVICE.—L.A/C. W. R. Callister; P/O. G. E. Coleman; Cpl. R. W. Crowe; Flt. Sgt. J. C. Davis; L.A/C. J. Farnworth; A/C.1 A. E. Ford; Sgt. A. F. Gooding; Grp. Capt. E. L. Gower, A.F.C.; F/O. F. Gwytber-Jones; Flt. Lt. H. Hollingdrake; A/C.1 J. H. Jones; A/C.2 L. Lucas; A/C.2 G. E. Meek; A/C.2 A. O'Mara; A/C.2 R. Shepherd; L.A/C. L. Stern.

Women's Auxiliary Air Force

KILLED ON ACTIVE SERVICE.—A/CW.2 E. Stretton.

Royal Australian Air Force

KILLED IN ACTION.—Sgt. G. L. Avern; Sgt. J. M. Hyatt; Sgt. G. Mutton.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. L. Brown; P/O. W. Goldman; Sgt. G. L. Skinner.

DIED OF WOUNDS OR INJURIES RECEIVED IN ACTION.—Act. Flt. Lt., R. H. C. Sly.

MISSING, BELIEVED KILLED IN ACTION.—P/O. R. Bond; P/O. G. G. Buckland; P/O. H. G. Burney; Sgt. J. F. Carpeander; Sgt. J. P. Cosgrove; Sgt. T. H. McIlveen.

MISSING.—Sgt. H. J. Hayes; Sgt. C. J. S. Parsons; Sgt. W. W. Perroux; Sgt. C. N. Reynolds; Sgt. L. M. Shephard; Act. Flt. Lt. E. T. Thompson.

KILLED ON ACTIVE SERVICE.—Act. Sgt. K. J. H. Manning; Sgt. J. K. Morris.

The operational control officer talking by radio to aircraft on their way home from one of the "over 1,000" raids.

Royal Canadian Air Force

KILLED IN ACTION.—Sgt. J. M. Hubbert; P/O. A. F. James; P/O. W. F. McCarthy; P/O. A. A. McNaughton; Flt. Sgt. N. K. Macleod; P/O. W. J. Murray; P/O. R. L. Payn; Sgt. W. T. Ramey; Flt. Sgt. J. Seberras.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. T. Best; Act. F/O G. E. Mitchell, D.F.M.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. G. J. McKhool.

WOUNDED OR INJURED IN ACTION.—P/O. R. H. Deugo; P/O. H. Hale; P/O. C. H. McCarthy; P/O. R. D. Milne; P/O. E. F. Paige.

MISSING, BELIEVED KILLED IN ACTION.—Sgt. G. P. Cushing; P/O. C. Kleckner; Flt. Sgt. H. D. MacPhee.

MISSING.—Flt. Sgt. A. C. V. Brophy; P/O. J. B. F. Brown; P/O. P. C. Budd; Sgt. T. A. Crawford; Sgt. J. H. Daughney; Sgt. R. B. Goodman; Flt. Sgt. A. A. Hemery; Flt. Sgt. V. E. McDougall; Flt. Sgt. J. G. Murray; Flt. Sgt. L. J. O. Roberts; P/O. J. H. Thomson; Sgt. R. E. Wilson; Flt. Sgt. W. J. Valkenier.

KILLED ON ACTIVE SERVICE.—P/O. F. G. D. Baker; P/O. F. W. G. Faunt; Flt. Lt. R. P. Maingay; Sgt. V. T. Wolfe.

Royal New Zealand Air Force

KILLED IN ACTION.—Sgt. J. W. Jasper.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—P/O. C. McD. Didsbury; Sgt. S. A. Dyer; Sgt. P. E. Hare; P/O. L. A. Wright.

MISSING, BELIEVED KILLED IN ACTION.—P/O. W. A. Caldwell; Sgt. L. J. H. Lincoln.

MISSING.—P/O. G. M. Densem; Sgt. D. J. McKenzie; Sgt. A. J. Macgregor; P/O. H. R. Mitchell.

KILLED ON ACTIVE SERVICE.—P/O. L. B. Ware.

DIED ON ACTIVE SERVICE.—Sgt. A. Stevens-Jordan.

South African Air Force

KILLED IN ACTION.—Lt. C. T. Dawson; Lt. C. F. Drake; Air Sgt. W. Sagar.

WOUNDED OR INJURED IN ACTION.—Capt. L. C. Botha; 2/Lt. N. W. Hancock; 2/Lt. D. Woodliffe.

MISSING.—Capt. D. Cobbledick.

WOUNDED OR INJURED ON ACTIVE SERVICE.—Air Mech. E. R. Berry.

Southern Rhodesian Air Force

MISSING.—Flt. Lt. B. Bowker.

Indian Air Force

KILLED ON ACTIVE SERVICE.—P/O. S. Bali.

DIED ON ACTIVE SERVICE.—Khan Zeb Muslin.